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THE PUBLIC RELATIONS OF SCIENCE[1]

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UNTIL recently the attitude of the public toward science seemed to be growing more appreciative. There have always been folk who objected strenuously to the supposed implications of certain scientific hypotheses, but on the whole science was generally esteemed the most progressive factor in culture, man's best hope for bettering his lot upon earth. Of late this tide of approval has ebbed. There is a widespread disposition to hold science responsible for the ills men are bringing upon themselves—for technological unemployment, for the rise of autocracies, for the suppression of freedom, for the heightened horrors of war. For their part, scientific men are appalled at the hideous uses to which their discoveries are put. They feel an urge to combat the misuses of science, to protect the social values they cherish, but what they can do is not clear. The quandary is one that all who cherish science should face, however unwelcome and difficult the task. I offer no apology for asking your attention to a discourse of uncertain issue on an unpleasant theme thrust upon us by developments we deplore.

[1] Address of the retiring president of the American Association for the Advancement of Science, Columbus, Ohio, December 27, 1939.

I

Let me start by recalling certain changes in the relations of science to society that may help us see our present problems in historical perspective.

The beginnings of scientific knowledge have been traced to man's dealings with the implements of his daily life—the sticks and stones, the skins, fibers and clay he shaped to his uses, and in the shaping learned to know. Human beings are born speculators; even the simplest cultures have their explanations of matters that puzzle us to-day—diseases, weather changes,

animal behavior, the creation of the world, what happens after death. Without this speculative bent human intelligence could not have evolved far; but neither could it win much useful knowledge without subjecting speculative explanations to practical tests. As the nursery of scientific thinking, the humdrum work of making and using household equipment had this great advantage: it required frequent repetitions under roughly similar conditions, when there was no great emotional stress, and when attention was centered upon immediate material results. In such activities it was least difficult to find out what operations were followed by the desired consequences, and what operations were superfluous.

Whether or not we accept this speculation about the humble beginnings of science, we know that at a later stage of cultural advance thinking about natural phenomena, like thinking about religious observances, tended to break away from direct associations with daily work. The slowly improving techniques of tracing the motions of heavenly bodies, keeping track of the seasons, measuring lands, developing mathematical propositions and erecting large structures called for unusual intelligence and training. Possessors of special knowledge wished to guard their trade secrets, to make mysteries of them, to initiate merely a few of their own choosing, and so increase their prestige. Mathematics is the subject least dependent upon the use of material objects, and it led the development of systematic thought, closely followed by its cousin, logic. Dealing with a rational universe of concepts, its affiliations seemed to be with religion and philosophy rather than with industry. So far as knowledge dissociated itself from technology, it escaped from continual subjection to matter-of-fact tests. That left it free to pursue attractive lines of speculation, but took away its most vigilant corrective and its sharpest spur to self-criticism. Even mathematical inquiry lost its momentum when it soared aloft in mystical flights.

Such efforts to understand the world as the Middle Ages made were concerned chiefly with problems of a divine dispensation. Observation was not pertinent, and factual tests of conclusions were not possible. The highest authority upon all questions was Holy Writ, which nobody might question and which the church interpreted. This orientation made acceptable the later Greek preoccupation with formal logic and disdain of matter. Aristotle, that great investigator, was transmuted into an obstacle to further investigation of mundane phenomena. Intellectual acumen achieved triumphs in its chosen fields, but understanding of natural forces was not prominent among them.

The re-birth of science in the sixteenth and seventeenth centuries was brought about by turning from the study of concepts back to the study of nature. The new orientation was characterized by close observation, by the invention of devices to make observation more penetrating and accurate, by purposeful experimentation to simplify the processes observed, by close attention to quantity as well as to quality, by the practical application of mathematics to express the relations observed, by reformulation of concepts to fit the findings, by critical checking of one investigator's work by others, by the cumulation of tested conclusions in old fields of research and by the extension of this mode of inquiry to new fields. Inventing instruments for observing, setting up experiments, measuring and testing brought science again into intimate touch with the practical arts. Investigators took a keen interest in current affairs, sought to profit by the skill of craftsmen and to put what they learned to practical uses. Discoveries were applied not only to the production of goods, but also to navigation, fortification, ballistics and administration. By the close of the seventeenth century the dramatic achievements of "natural philosophy" were leading many to expect an almost limitless advance, and the promotion of science was recognized as a proper object of public policy. Kings lent their patronage to scientific societies. Philanthropists followed the royal precedents by offering prizes for improvements in the arts and later by endowing research.

Of course the public relations of science were not uniformly harmonious in this age of genius. But the celebrated clashes between scientific discoveries and beliefs held by churchmen did not affect many lines of inquiry and did not gravely retard the rising tide of investigation. Not less characteristic of the age than Galileo's troubles were Newton's services to churchly teachings and to the state. Scientific men have lamented that he devoted his later years to arguing the validity of biblical prophecies; they have paid less attention to his work as Master of the Mint. It was adjustments in the relative weight of the guinea and the shilling suggested by Newton that gave England a *de facto* gold standard in the eighteenth century, though Newton did not foresee this result.

An even more striking example of close relations between research and service to mankind is the life of Benjamin Franklin. The foremost American discoverer of his time, he was foremost also in applying and disseminating science to make life more comfortable, more secure, more interesting, more humane. These activities were incidents in the life of a busy printer, editor, politician, postmaster, legislator, colonial agent and diplomat. But while we wonder at the extraordinary versatility of a man who could become both a scientific discoverer and a great states-

man under any conditions, we must remember that in Franklin's day science was still in its "natural philosophy" stage.

With the cumulation of results, science became a more exacting mistress, requiring of her votaries more exclusive attention. But science did not draw away from the material tasks of daily life as it did in Greece. On the contrary, these relations were becoming more intimate, while scientists were learning to speak symbolic dialects less and less intelligible to the public or even to one another. Let me illustrate the seeming paradox by the relations between science and industry.

To most of us the modern age is characterized by technological progress as markedly as by scientific discovery. We think of the two achievements as interdependent. This interdependence was less obvious to Franklin's contemporaries than to us. Theirs was a century of great inventions, but inventions made mostly by men not trained in science. The famous "agricultural improvers" worked by empirical methods. The great textile inventions came from handicraftsmen, one of them a barber. Metcalf, Telford and Macadam, the road builders, were "practical men"; so also was Brindley, the canal builder. Newcommen, "father of the steam-engine," was an ironmonger and blacksmith; his co-worker, Cawley, was a plumber and glazier. The Darbys, who found out how to smelt iron with coke, began as small ironmasters. A few inventors, it is true, tried methodically to discover scientific laws—Smeaton and Watt are eminent examples. Also, some scientists developed inventions out of their discoveries, as Franklin did with the lightning rod, and some set deliberately about the solving of industrial problems—Leblanc developed his process of making soda to win a prize offered by the Paris Academy of Sciences. But these instances were harbingers of a coming day rather than representative products of the eighteenth century.

This new day brought with it a division of labor in the conduct of industry matching the specialization evolving in science. The captains of industry who carried the Industrial Revolution through its youthful phases were often technical experts, business executives and capitalists united in one person. Men of this versatile type are still to be found even in "big business"; but they are becoming as rare as once they were common. For, as technology was elaborated, experts with special training were required to supervise its operations. Engineering became a learned profession—or rather a family of learned professions that multiplied by fission. It won a place in institutions of higher learning beside theology, law and medicine. Inventions continued to come from geniuses with little training, but more and more of them were made to order by experts. Business management meanwhile became so intricate, what with its problems of financing, selling, accounting, selecting personnel, planning investments, and the like, that a good-sized corporation required a staff of men with different skills to do part of the work that an old-fashioned captain of industry had performed for his small establishment. With a considerable lag behind engineering, business administration also raised claims to professional standing and developed schools of its own. As for capital, the requirements of business utilizing modern technology speedily outran the resources of the single enterpriser or partnership. By a series of inventions not less important than those of mechanics, methods were developed for bringing together the savings of countless individuals, rich and poor, by providing types of securities well enough adapted to their several needs to attract funds.

With this double division of labor, in science and industry, the scientist could stick closely to research and feel confident that whatever applications of his discoveries were feasible would be taken in hand by men who knew more about industry than he. The engineer could devote himself as sedulously to technological matters, putting research problems up to laboratory workers and leaving business worries to executives. The latter could get technical experts of many sorts from the schools, and could expect cumulative improvements in technology from the joint labors of scientists and engineers. Investors frequently knew little about the enterprises for which they provided capital; they inclined to rely upon the advice of professional financiers and to protect themselves by spreading risks.

The economic results produced by this unplanned organization of mutually stimulating activities astonished mankind. Industry after industry reorganized its processes time and again to take advantage of the latest engineering applications of scientific discoveries, and new industries kept cropping up. The efficiency of human labor increased greatly, per capita income rose, and hours of labor declined. Higher standards of living and applications of science to the prevention and cure of disease reduced death rates and prolonged the average duration of life. Population grew rapidly in the nations that led the scientific procession, and spread where it would over the earth, dominating, exploiting, sometimes exterminating the non-scientific peoples. Life became ampler if not easier for the beneficiaries of science.

What industry owed science is repaid in many ways. It provided in bewildering variety laboratory equipment more accurate and powerful than that made by hand. It stood ready to construct any new contrivance an investigator designed, and often im-

proved upon the original plans. Fortunes accumulated in business were the source of many scientific endowments. Business corporations granted research funds to universities, and set up research staffs of their own, which were sometimes permitted to work upon fundamental problems.

Governments recognized the social importance of science by making place for an expanding array of scientific courses in public schools and universities, and by undertaking wide-ranging programs of research. In this country, the Federal Government became the largest employer of scientific men. At the time of the Civil War it chartered the Academy of Sciences, and in the World War the National Research Council to advise it upon scientific problems; in 1934 it set up the organization that has developed into the National Resources Planning Board with affiliations covering the full gamut of the sciences.

Finally, the public at large had a share in these great changes. It was the ultimate beneficiary of reductions in costs of production, of increasing per capita output, of new types of consumers' goods, of shorter working hours, of better protection against disease, of free education. And this share was not wholly passive. Wage-earners adapted themselves with less friction than might have been expected to the working conditions imposed by the new technology. If many disliked the impersonal regimentation of the factory and the monotony of machine tending, others delighted in their control over stupendous forces, in the precision of the work they turned out, in the efficiency of the organizations of which they were parts. It is a grave mistake to overlook the enthusiasms evoked by machines, big and little. As recent experience in Russia reminds us, a population that has not become mechanically minded in large measure can not effectively use modern technology. And at home the masses welcomed factory-made goods. In successive generations they thanked engineering and science for illuminating gas, sanitary plumbing, kerosene, telephones, electric wiring, inoculation against epidemic diseases, automobiles, motion pictures and radios. Almost every one participated in scientific discoveries to the modest degree necessary for using these contrivances with some skill. Besides material products, many folk enjoyed what Tennyson called "the fairy tale of science"; their thoughts were pleasurably enlarged by the telescope and microscope. Pasteur, Edison, Mendel, Mme. Curie, Einstein became romantic personalities to tens of thousands, rivaling in popular appeal politicians, business leaders, actors and athletes. Without this eager welcome from society at large, government, business and schools could not have fostered research as they did, and science could not have progressed so rapidly.

It can not be said that these eminently cordial relations between science and the public were consciously engendered by scientific men. Now and then when some scientific hypothesis or procedure was attacked, individual scientists rushed to the defense and sometimes organized protests by scientific bodies. The controversies over what the public called "Darwinism" and "vivisection" are examples. Also scientists answered calls for their services freely and took advantage of opportunities to make their livings on lecture platforms, in schools, governmental bureaus and business enterprises. On appropriate occasions they dilated eloquently upon the service of science to civilization, and investigators with skilful pens and need of royalties wrote popular books. But most of the men who made modern science what it is devoted themselves single-mindedly to research. Their deeds, not their words, won the esteem and raised the hopes of mankind.

In short, this policy of *laissez-faire* worked wonders. Science helped industry, and industry helped science. Even the backward art of agriculture, which faces so many difficulties and uncertainties, was benefiting by research. The dreaded "law of diminishing returns" seemed to be overbalanced by improvements in practice based upon the work of soil chemists, botanists and geneticists. The frightful prospect of overpopulation that Malthus had taught the thoughtful to fear seemed to be dissipated by scientific agriculture and scientific techniques of contra-conception. Best of all, science seemed to have found the secret of illimitable progress. What it had done was merely an earnest of the greater things it would soon do. One discovery led to another so continuously that men began to take for granted a cumulative rise in the standard of living. They moved the Garden of Eden from its traditional place at the beginning of human history into the calculable future, dreaming of a world from which poverty would be banished. If some souls felt oppressed by the materialism of the age, youthful sages arose from the non-scientific peoples to argue, in the words of Hu Shih, that there is more of the spiritual in the scientific effort to control natural forces than in passive resignation to poverty and disease.

II

I doubt that any scientist ever accepted without qualification this idyllic version of the benefits science confers upon mankind. Certainly there were numerous protests from scientific quarters against misuses of the new technology. Geologists and economists warned against the rapid depletion of mineral deposits. Chemists feared for the nitrogen content of the soil. Geographers and meteorologists protested that wholesale cutting of forests and the plowing of

grass lands produced deserts. Biologists lamented the extinction of animal species and anthropologists the callous stamping out of simpler cultures. Social scientists found much amiss within the countries that were most progressive. Urban and rural slums persisted as centers of disease and crime. The need of securing capital to utilize the new technology put control over it into the hands of the propertied classes. Labor was often grievously exploited. Huge fixed investments that could be used for only one purpose made competition destructive. The obvious escape from these hazards was to form monopolistic combinations. That was pleasant for the monopolists, but not for other business men or for consumers. Besides the obvious dangers of exploitation, many feared that the great combinations might purposely slow down technological advance because it threatened rapid obsolescence of their equipment. Business did not manage even its own interests properly, for every few years it generated a crisis and depression in which it suffered along with the whole community. And the international relations of the scientifically advanced peoples showed at his worst "the old savage in the new civilization." Demonstrations of the economic advantages of free trade no more stopped the imposition of protective tariffs than demonstrations of the horrors of war kept peace. Militant nationalism seemed to be spreading and growing more passionate. An appreciable fraction of scientific energy was devoted to contriving weapons of destruction. Thus against the glowing picture of science as a benefactor of mankind could be set a dark picture of science putting more power into the hands of certain individuals, classes, nations, generations, giving them a differential advantage over others which they exploited according to their several natures.

Though some of the Jeremiads I have been recalling belong to an earlier time, they did not produce a profound effect upon the public relations of science until recently. The ills complained of could be regarded as "growing pains." They were thought of as social "problems," which should be dealt with by arousing public opinion in a campaign of education that would lead to remedial legislation. Problems that could not be solved by this time-honored method would yield presumably to the slower processes of general enlightenment.

This optimistic attitude was particularly characteristic of democratic nations. It assumed tacitly that experts could devise whatever "reforms" were needed, and that the majority of voters were intelligent enough to understand and well disposed enough to support desirable changes. Science had a stellar role in this program for remedying the ills incidental to progress. It did not claim knowledge of good and evil; but it enabled men to make their value judgments more intelligent by tracing the consequences of actions. Many people were devoting their energies to the study of social problems; they spoke optimistically of their subjects as social "sciences." It seemed not too much to hope that science might presently begin to guide social practice in somewhat the same fashion as it guided practice in industry and medicine.

A man might be skeptical of the nascent social sciences; but he could scarcely deny that the leading scientific nations managed to readjust their economic, political and social institutions when the new technology produced results they deemed bad. True, the readjustments were usually made by attacking one evil at a time, without due consideration of indirect consequences, which were often unfortunate in good part, and sometimes canceled the gains. Also the processes of reform lagged so far behind the changes produced by applications of scientific discoveries that new troubles began and new social adjustments were needed before the preceding reforms had been perfected. Despite all this, the scientific nations believed themselves to be evolving a social order adapted to the times—one that enabled them to grasp ever more fully the ever larger benefits scientific progress was bestowing upon mankind. I question whether history can show another period in which human hopes soared so high as in the closing decades of the century between Waterloo and the first World War.

III

That the public relations of science have recently become disturbing both to the public and to scientists is due, not to any change in the character of science or the behavior of scientists. but to changes in social conditions. While most people approved on the whole the applications of science before 1914, they have come to dislike many of the effects produced by later applications. To be specific: when scientific improvements in one industry after another threw men out of work in earlier decades, the victims might suffer in silence or protest riotously and perhaps smash machines. But the public at large was not deeply concerned over their sufferings; it repressed disorder, expected the displaced men to find new jobs for themselves, and blessed science for reducing costs of production. Now that a larger part of the public suffers from loss of work or obsolescence of investments, science is blamed for technological unemployment. When the modern arts of communication were used to facilitate the political processes of democratic nations, they were extolled on all sides. Now that these arts, further improved, are controlled in some countries by autocratic governments and used to suppress opposition, many good people treat science as the culprit. When the scientific nations used their

superior arms against backward peoples, only a few sensitive souls were wrathful over the unfairness or iniquity of the procedure. Most people felt that science was good when it gave them a decisive advantage over those they wished to "civilize." Now that these same nations are threatened by still more terrible weapons in the hands of their peers, their moral horror is sincere, and they wish scientific warfare back to the pit from which it was digged.

This shift in attitude toward science as one happens to benefit or suffer from its applications is doubtless a mark of human frailty, but it is one at which scientists should not cavil without recalling a similar frailty of their own. Now that we are on the defensive, we discover that science is neither good nor bad in itself, but is merely an instrument that can be put to good or bad uses, and that the blame for bad uses should be visited upon those responsible for them. But when science was being lauded for good works, who among us argued that the credit belonged, not to science, but to those who used it for the benefit of mankind?

We made this discovery when difficulties forced us to think more carefully about the place of science in society. Well as the old policy of *laissez-faire* in public relations worked for a time, it had encouraged in us an indolent complacency foreign to the critical spirit of inquiry. We may not enjoy the shocks that have aroused us any more than an investigator rejoices over facts that disprove an elegant hypothesis; but we must face the situation and see what we can do to mend it. Every one concerned with the future of science or of mankind bears a share in the responsibility for trying to understand the present situation, and to decide what action, if any, is called for. It is not likely that a satisfactory solution can be produced in short order, for the problem is one of numerous variables in shifting combinations. But I venture to suggest an obvious proposition that seems to me of controlling importance, and to point out certain corollaries that should guide both our attempts to understand the public relations of science and our future policy concerning them.

IV

The fundamental proposition is that scientific research is a social process as much as business, political or religious activities are, and as such is interwoven with all other social processes, influencing them and being influenced by them.

My historical sketch of the public relations of science supports this view. But let me borrow two illustrations from thoughtful physicists. David L. Watson has shown that social institutions impose their pattern upon research, putting a premium upon conventional inquiries and obstructing originality. Like other social activities requiring close cooperation, research gets organized, organizations become bureaucratic, bureaucrats may have routine efficiencies, but originality of thought and cordial welcome to originality in others are not conspicuous among them. Watson compiles a formidable list of instances in which scientific organizations have been slow to recognize fundamental discoveries, and he makes his point more uncomfortable by naming certain rather odd contemporaries who may be doing work more important than the men to whom we award medals.[2]

In a way that should come close home to every investigator, P. W. Bridgman has pictured the intellectual struggles a scientist must undergo if he strives seriously to live "an intelligently well-ordered life." Accustomed to subject his concepts in physics to operational tests, Bridgman tried to treat with similar rigor the concepts that count most in social intercourse. The results were disconcerting.

> Not one of our social institutions (he found) rests on the secure foundation that we so easily assume when we refute the skeptic or instruct our young. Never has any institution been justified in terms that anyone capable of close thinking could accept without stultification. Yet if ever the tragic need for close thinking and intelligent convictions on social questions was obvious it is at the present.

This loose thinking that characterizes social intercourse introduces confusion into the lives of all, though the confusion may be recognized only by those who try to live intelligently. For every one derives the words in which he thinks from society. They bring into mental processes all sorts of implications inherited from the past that will not bear analysis, and from which one can free oneself only by laborious analysis of the sort that has made the exact language of physics differ from the ambiguous language of everyday life.[3]

Scientific research, then, is one among many social activities carried on by the peoples of our culture. Like all such processes, it is carried on by men who learn in childhood languages ill suited to close thinking; by men who wish to eat, to make love, to win approval as well as to know; by men who are reared in an environment of emotional likes and dislikes; by men who become so absorbed in their technical tasks that they have little energy to criticize the nonscientific parts of their own make-up. And these scientific men form a tiny fraction of their communities. So far as they succeed in emancipating themselves from the misconceptions and prejudices pre-

[2] David L. Watson, "Scientists are Human," London, 1938.

[3] P. W. Bridgman, "The Intelligent Individual and Society," New York, 1938.

vailing in their social groups, they become by virtue of their partial emancipation queer creatures whose judgment most people mistrust outside of their specialties. Both the temperament that inclined them to research and the habits they form in research tend to make them awkward, ineffective, reluctant in appealing to the emotions that are so potent in influencing men. It is difficult to see how a few scattered individuals, each accusomed to think for himself and to be critical even of his fellow inquirers, can guide public opinion except by slow educational processes. In the long run their thinking may rule the world, just because it serves the purposes of mankind better than the traditional thinking it gradually replaces. But in the short run, others take of scientific discoveries only the parts that have an immediate application, and put these parts to such uses as they see fit—uses that serve whatever aims these others pursue. The prompt and potent influence of science upon society comes from these uses, good and bad, which scientists control only in small part.

Even in democratic countries, then, scientific men find it hard to bridge the gulf between their attitudes and those of the general public. In autocratic states the governments might give scientists fuller opportunities to direct public policies than they enjoy in democracies. But the autocratic states known to us are not built on that model. They are avid for science, to be sure, but only for science that is an uncritical servitor of ends the rulers determine. As between the difficult public relations confronting them in democracies and the shackling of free inquiry confronting them in autocracies, scientists can not hesitate. Theirs is a world of intellectual freedom, not perfect, alas, but the freest world the mind of man has yet created, and to let any authority under any pretense prescribe what conclusions they shall accept as scientific is to stultify the spirit of science.

V

What, then, can scientists do to improve their public relations in communities where they are relatively free?

As I see the situation, they have two sets of opportunities and responsibilities: first, their opportunities and responsibilities as citizens; second, their opportunities and responsibilities as investigators.

It must be admitted that to many scientific men the performance of civic duties is an unwelcome interruption to their research work. Some brilliant investigators are temperamentally unfitted to share in the tumultuous processes by which a democracy reaches its decisions. Among the great discoverers of the past there have been cynics who despised the "common herd," recluses who could scarcely endure social contacts, geniuses so erratic that their judgments upon practical affairs seemed crazy, rationalizers who urged the insignificance of one citizen among millions as an excuse for shirking responsibilities. Presumably representatives of these types exist among our scientific contemporaries; but I know no ground for supposing that they form a larger proportion of the persons listed in Dr. Cattell's "American Men of Science" than of those listed in "Who's Who in America." A goodly majority of scientific men have normally balanced personalities and are competent citizens. They can be counted upon to take their civic responsibilities as conscientiously on the average as any other group, and to act with as much commonsense.

What scientific men can do as citizens is like what other intelligent men can do. If democracy is to work well, many people must form considered judgments upon a wide variety of problems. In forming a considered judgment on a given issue, what experts have to say should be taken into account. Who these experts are depends upon the character of the issue; more often than not contributions are needed from several kinds of specialists. All the many species of the genus scientist belong at one time or another in the list of desirable technical advisers; so also do lawyers, business organizers, labor leaders, social workers, educators, civil servants, politicians, and so on. When matters within the competence of some group of scientists are involved, they should contribute what they know, whether formally invited to do so or not. To make their advice effective they should welcome help from people more skilled than themselves in the arts of popular presentation. On matters concerning which a scientist has no special knowledge, he should listen to others and form the best judgment he can from what they advise. To an individual this task of sifting and weighing different opinions is time-consuming and difficult. On complicated issues organization is needed to bring into focus all the intelligence available in the community. Hence, one of the civic duties incumbent upon all scientific men in common with other citizens is to support vigorously but critically the nascent movement toward organizing all the intelligence we possess for constructive study of social problems before they become pressing emergencies that have to be dealt with in a hurry that allows no time for careful thinking.

The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not merely does no individual have more than a tiny fraction of the knowledge that is needed; all the scientists of the country put together do not know enough to solve many of the problems that a democracy faces. In addition to the responsibilities they share with all other citizens, scientific men have the special duty of

trying to increase the kind of knowledge required to deal intelligently with public problems. Their opportunities and responsibilities as citizens merge into their opportunities and responsibilities as investigators.

From the social view-point, the most urgent item in the unfinished business of science is to increase knowledge of human behavior. If we had keener insight into individual psychology, we might not be able to alter fundamental drives, but we might be able to direct them into beneficent channels. Preaching righteousness doubtless prevents men from being as bestial as they might otherwise become. Appeals to reason prevent them from making as many errors as they otherwise might. But the moralist and the rationalist admit that the results of their efforts are grievously disappointing. Scientific men with any gift of self-analysis realize that they have their own shares of selfishness and animosities. To subdue traits in oneself is hard enough to give an inkling of the difficulty of controlling them in society at large. Perhaps, and perhaps is all we can say, if we can come to a clearer understanding of how we behave, we can learn how to condition men so that their energies will go less into making one another miserable.

One of the things we have learned about individual behavior is that it is influenced greatly by social environment. In John Dewey's phrase, "all psychology is social psychology." Improving knowledge of social organization and its working is therefore part and parcel of the urgent task of learning how men behave. Though we may believe ourselves citizens of the most fortunate nation in the world, we have no more reason for complacency about the way in which our social organization works than for complacency about individual behavior. For example, our economic organization does not permit us to buy from one another as much wealth as our workers are able and eager to produce. Even in the best of years we fail to provide a national income large enough to give American families on the average what experts on household economics hold to be a standard of living adequate to maintain efficiency. In bad years this inadequate income falls off by a fifth or a sixth; in the very worst years by 40 per cent. or more. All this is true of our industrial equipment and practice as they stand. Proud as they are of our technological progress, engineers know that much of our equipment and many of our methods are far behind the times. We fail to make full use of knowledge that technological applications of scientific discoveries have put at our disposal. I might develop the shortcomings of our economic organization at great length, and then go on to exploit the weaknesses of our political and social institutions. It is needless to do so; for every candid and intelligent citizen can point out defects, however convinced he may be that, with all its faults, the American scheme of institutions is the best in the world. If scientists can do more than other intelligent citizens toward improving social organization, their contribution will consist in raising knowledge of social practice.

We all know that the social sciences lag far behind the natural sciences. That is because they deal with phenomena more complicated, more variable and less susceptible of experimental manipulation. Since investigators can not experiment at will upon social groups, they can not effectively apply to their problems the methods that have made the laboratory sciences strong. Max Planck once told J. M. Keynes that in early life he thought of studying economics, but found it too difficult.[4] Of course economic theory as we have it to-day is far easier to master than physical theory. But Planck was a true scientist, one who wished to gain knowledge that accounted for actual phenomena. He had learned enough to realize that it is far harder to get such knowledge of economic than of physical processes.

Yet the case of economics and its sister sciences is not hopeless. The rapid growth of statistics is providing mass observations upon social behavior of many kinds; the equally rapid growth of statistical technique enables us to learn more from a given array of data than our predecessors could. These materials and methods are making it possible to measure many social factors, some rather accurately, some roughly. Uniformities appear not only in averages but also in the way in which individual items are distributed about their means. Statements in terms of probability can be substituted for vague statements about the effect a certain cause "tends" to produce. True, work on this observational basis encounters many difficulties. It is limited by the variety, extent and accuracy of reliable data upon human behavior. It is laborious, slow and expensive. In presenting his work a realistic investigator begins with a critique of his data and methods, he ends by setting forth the probable errors and limitations of his results, and the road from the beginning to the end may be long. Instead of definitive conclusions he thinks others should accept, he presents tentative approximations he expects others to improve. The work has not even the advantage of calling for less hard thinking than speculative theorizing; for the relations among the variables in the problem are seldom manifest of themselves. All that can be claimed for this type of work is that it deals with actual experience, that its results stand or fall by the test of conformity to fact, and that it grows cumulatively after the fashion of the

[4] "Memorials of Alfred Marshall," edited by A. C. Pigou, London, 1925, p. 25, note.

observational sciences. But that is enough to give mankind strong reason for following this lead in seeking the knowledge required to improve social organization.

I do not imply that the social sciences can rapidly become such assured guides to social progress as the natural sciences are to technology. Because of difficulties inhering in their subject-matter, the social sciences will continue indefinitely to lag behind the natural sciences in precision and reliability. For a long time to come we shall have to form our opinions on many social issues in the light of common sense rather than of science. Knowledge of past experience should prove helpful in this uncertain process, and advice from specialists who have studied this experience should be sought. But wise technical advisers in these difficult matters will not pretend to certitude. As citizens we shall do well to suspect the intelligence, the candor or the disinterestedness of those who promise sure cures for social ills.

Scientific men are wont to face facts, whether these facts conform to their wishes or not. Most of them are sufficiently emancipated from conventional thinking to look critically upon social institutions. They contrast the society of to-day with its poverty in the midst of plenty, its class, racial and international animosities, its puerile aims and its destructive methods, to a society they can imagine living in security and comfort, using its increasing knowledge to provide a finer life for all mankind. This contrast should not be accepted in a spirit of resignation. It is a call to action. But scientific men will not be true to their own standards, they will not render to society the largest service of which they are capable, if they let their actions be guided by their feelings. No current discouragement should blind us to the great strides in human welfare made since science assumed its modern form; no fit of impatience over delays and relapses should make us forget that knowledge is won step by step, through the toilsome efforts of thousands of men. To jump this work with its numberless failures and its gradually cumulating successes, expecting to land in Utopia, is to give up faith in science for faith in magic. Men who take scientific methods seriously as the best hope of floundering mankind will seek to apply them just as critically and remorselessly in their social as in their physical thinking.

But science can not flourish in the future and yield the fruits for which we hope unless freedom of thought prevails. That is a condition we have been inclined to take for granted as part of the heritage our predecessors won. Now we realize that what they fought to win we must fight to maintain. The investigator's right to follow truth wherever it led was part of the common man's right to freedom of conscience and freedom of speech. These rights were established by political struggles and embodied in political institutions. The democratic way of life and the scientific way of thinking grew up together, each nourishing the other. If one now fails the other will falter. Where democracy is suppressed to-day science is fettered; for autocracy can not brook disinterested criticism of its dogmas or its practices. Freedom of scientific work in the years to come can be guaranteed only by preserving the institutions that secure freedom to all citizens. Perhaps scientific men have more at stake than any other social group in the struggle to maintain democracy.

To this struggle they can make a crucial contribution. The fate of free societies hangs upon the wisdom or folly of mass decisions. The gravest dangers to democracy come from within, not from without. They are ignorance and propaganda that turns ignorance to its uses. The best way of dispelling ignorance is by diffusing knowledge. The most effective defence against meretricious propaganda is critical inquiry. John Dewey is warranted in saying that "the future of democracy is allied with spread of the scientific attitude."[5] To foster this attitude among their fellow citizens by all means within their power is a duty incumbent upon us who cherish science. As teachers in schools and colleges we can help thousands to develop respect for evidence. As citizens we can be brave opponents of prejudice and hysteria. We can promote general understanding of the methods and results of science through our own writings or those of allies more skilled in popular exposition. These things we should do, not as high priests assured that they are always right, but as workers who have learned a method of treating problems that wins cumulative successes, and who would like to share that method with others.

OBITUARY

FREDERICK ADAMS WOODS

FREDERICK ADAMS WOODS was born at Boston, on January 29, 1873, and died on November 5, 1939, in Rome, Italy. His father was Solomon Adams Woods, who, born in Farmington, Maine, 1827, came to Boston about 1847 and became a successful manufacturer of wood-working machinery. Frederick Adams Woods's mother was Sarah C. Watts. She was fond of study. Her father was a seafaring man whose later life was spent in Boston devoted to study, especially of mathematics. Frederick's career was largely determined by

[5] "Freedom and Culture," New York, 1939, p. 148.

the heritage and environment into which he was born. He had a love of study and was especially interested in the application of mathematics to biology. He became, as Henry F. Osborn once called him, "the American Galton." He inherited a patrimony that left him relatively independent. He became one of the few scientific amateurs of his time in America.

Woods studied at the Massachusetts Institute of Technology from 1890 to 1894, graduating precociously. But his interest was man, so he studied at the Harvard Medical School (graduating in 1898) and remained there to teach histology and embryology for four years. He then became connected with M.I.T. as lecturer in biology and so remained for twenty years.

Woods was actively employed in study during these years of comparative freedom from the necessity of earning a living. His first book, "Mental and Moral Heredity in Royalty" (1906), was a contribution toward "the science of history"—a science based on statistical analysis. His book opens with a regret that "so little attention is paid to heredity in the biological sense." The work struck out on new lines. Seven years later (1913) was published his "The Influence of Monarchs; steps in a new science of history." This work correlated the qualities of the rulers (classified in three grades) with the condition (in three grades) of the countries over which they ruled. Here he concludes: "The true interpretation of history must hinge upon the gametes."

It was during the time between the publication of these two books that Woods sent to SCIENCE his paper, "Historiometry as an Exact Science," in which he analyzes at some length (as an illustration of method) the relative eminence of Euripides and Sophocles. Historiometry was the keynote of most of Woods's later work. In his researches he made much use of photographs of past monarchs and others, and this led to his discussion (1919) of evolutionary changes in type of face of the New England stock.

The World War aroused an especial interest in Woods. With Alexander Baltzby ("Adams Woods fellow in Harvard University"), he wrote a book on "Is War Diminishing? A study of the prevalence of war in Europe from 1450 to the present day" (1915). This study also is quantitative; it shows up Prussia as the most pacific of the European powers.

Woods was a man of rather striking personality, nearly six feet tall and slender—decidedly of the respiratory type. His intellectual interest was always in the biology of man, especially dynamical man. That is why teaching histology and embryology at the Medical School did not satisfy him. As early as 1899 he began to breed rabbits to test Galton's Law of Ancestral Inheritance and, in 1903, published in *Biometrika* a paper on "Mendel's Laws in Rabbit Breeding." He took very active interest in the American Breeders Association and its successor, the Genetic Association. During 1918–19 he was editor of the *Journal of Heredity* and contributed numerous articles on human heredity to it. He participated on committees of the Eugenic Congresses. The Galton Society was one of his main interests before he left this country to reside in Rome. He was elected president of the Eugenics Research Association, but his health did not permit him to serve. As a speaker and writer he was always clear and very serious. His life work was all a labor of love and a product of his rare personality.

CHARLES B. DAVENPORT
COLD SPRING HARBOR, L. I., N. Y.

FRED WILLIAM TINNEY

FRED WILLIAM TINNEY was born at Saco, Montana, October 30, 1907. After graduation from the local high school, he entered the State Teachers College, Oshkosh, Wisconsin, where he received the degree of B.Ed. in 1929. He spent two years at the University of Oklahoma as assistant in botany, taking an M.S. degree in 1931. He then came to the University of Wisconsin as research assistant, which position he held until his appointment, in February, 1936, as assistant agronomist in the Bureau of Plant Industry of the U. S. Department of Agriculture, stationed at the University of Wisconsin, Madison, Wis. The degree of Ph.D. was received in 1933.

He married Madeline Morrissey on June 12, 1939. Both Dr. Tinney and his wife attended the International Congress of Genetics at Edinburgh. Both were passengers of the ill-fated *Athenia,* sunk off the coast of Scotland, on September 3, 1939. They were among those listed as missing since the disaster.

Dr. Tinney's research included a thoroughgoing study of heteropycnosis in two species of *Sphaerocarpos.* After this came an investigation of the cytology of an ornamental grass, *Agrostis nebulosa.* This led naturally to the study of the genetics and cytology of pasture grasses. After Dr. Tinney's appointment in the Bureau of Plant Industry, work in this field was carried on at Madison in cooperation with the department of agronomy of the University of Wisconsin. A paper embodying his extensive studies of blue grass (*Poa pratensis*) is in press. This grass has been the source of much confusion because of the multitude of races included within the species and of the variety of chromosomal conditions which these races manifest. Tinney's observations and studies of the peculiar methods of embryo-sac and embryo-development characterizing the species, go far toward explaining the peculiar genetic behavior of its varied forms. It promises, too, to supply a basis for the selection and breeding of improved strains of this and other grasses—a relatively new field of endeavor in America.

Deeply devoted to fundamental research in accord-

ance with his training and inclinations, Dr. Tinney in his later work developed a keen insight into the applied aspects of his studies. Quiet and unassuming, he was highly respected by his fellow workers and many friends, who recognized in him the qualities of substantial leadership among the younger group of American scientists.

CORRESPONDENT

HENRY CLINTON FALL

MOST people are not aware that the fauna of the United States is still very imperfectly known. Among the insects, in particular, new species can still be found in great numbers, and of most of those which have been described, little or nothing is known of their life history and habits. There is thus an immense task before us, to culminate eventually in a work of many volumes, describing the life of this continent in all its details. Such a work can never be really complete, but it might be as nearly so as existing treatments of the fauna of the British Islands or Central Europe. There is no organized effort to reach such ends, but many workers are dealing successfully with particular groups of animals, defining families, genera and species, arranging them according to their apparent natural affinities. During the past forty-five years, the name of Fall has been well known to all those concerned with American beetles. Henry Clinton Fall was born at Farmington, N. H., in 1862, and died at Tyngsboro, Mass., on November 14, 1939. He graduated from Dartmouth College with the degrees B.S. and Sc.D., the latter honorary. When I first knew him he was resident in Pasadena, Calif., happy in the extraordinary opportunities for the study of Coleoptera which he found in the arid southwest. He had been interested in the subject for fifteen years before he began to publish, but once he began to record his observations he soon became a prolific writer, especially known for his excellent revisions of various groups and important faunal papers, such as those dealing with Southern California, with New Mexico and Alaska. He described over 1,400 new species of beetles, and had one of the finest collections extant. All this was done in his so-called leisure time; he earned his living by high-school teaching. His entire collection goes to the Museum of Comparative Zoology, Harvard University.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

RECENT DEATHS AND MEMORIALS

DR. CHARLES ZELENY, research professor of zoology, who had been a member of the faculty of the University of Illinois since 1909, died on December 21 at the age of sixty-one years.

FERDINAND AUGUSTUS SILCOX, chief of the U. S. Forestry Service, died on December 20. He was fifty-seven years old.

DR. HUGH KELSEA MOORE, for thirty years before his retirement in 1934 chief chemical engineer of the Brown Company, Berlin, N. H., died on December 18 at the age of sixty-seven years.

THE College of Medicine of the State University of Iowa has received a gift of $5,000 from Mrs. Edith Graham Mayo, of Rochester, Minn., in the name of herself and the late Dr. Charles H. Mayo for the establishment of a memorial to their son, the late Dr. Joseph Graham Mayo. The fund is for the support of a lectureship or research scholarship. Dr. Joseph Mayo was a graduate of the Iowa College of Medicine in 1927, who died in 1936.

SCIENTIFIC EVENTS

THE STATUS OF THE ENGINEERING PROFESSION

THE Engineers' Council for Professional Development, a joint cooperative body of seven engineering organizations, through its 1938–1939 Committee on Engineering Schools, of which Dr. Karl T. Compton, president of Massachusetts Institute of Technology, was chairman, has issued a list for 1939 containing 525 accredited undergraduate engineering curricula leading to degrees in 118 colleges and universities in the United States.

Since the inauguration of the accrediting program in 1935, the committee through its committees on inspection has appraised the various curricula in each school separately, considering such factors as qualifications of the faculty, standards of instruction, scholastic work of the students, records of the graduates, attitudes of the administration, as well as physical facilities, finances, requirements and size of staff and student body. According to Dr. Compton's report,

> while the committee has adhered rigidly to the policy that it should set no fixed standards for use as yardsticks in measuring the quality of engineering instruction, one principle however has been insisted upon, namely, that if any curriculum omits some portion of a subject in which the engineers in that field are expected by the public to have competence, then under such conditions the committee insists, as a necessary safeguard to the public, that the curriculum be not accredited. . . . However, it aims to preserve the independence of action of individual institutions and to promote thereby the general advancement of engineering education.

Besides Dr. Compton, other members of the Committee on Engineering Schools included: H. P. Ham-

mond, dean of engineering, the Pennsylvania State College, *vice-chairman,* representing the Society for the Promotion of Engineering Education; G. M. Butler, dean of engineering, University of Arizona, representing American Institute of Mining and Metallurgical Engineers; Ivan C. Crawford, dean of engineering, University of Kansas, representing the American Society of Civil Engineers; P. H. Daggett, dean of engineering, Rutgers University, representing the National Council of State Boards of Engineering Examiners; A. B. Newman, College of the City of New York, representing the American Institute of Chemical Engineers; A. A. Potter, dean of engineering, Purdue University, representing the American Society of Mechanical Engineers; D. B. Prentice, president of the Rose Polytechnic Institute, and J. R. Killian, Jr. of the Massachusetts Institute of Technology. Dean Potter has been chosen chairman of the 1939–40 committee. J. W. Barker, dean of engineering, Columbia University, succeeds Dean Hammond on the committee and E. L. Moreland, dean of engineering, Massachusetts Institute of Technology, replaces Dr. Compton. President R. E. Doherty, of the Carnegie Institute of Technology, succeeds Dean Daggett on the committee.

THE FRANCIS AMORY SEPTENNIAL PRIZE OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

IN compliance with the provisions of the will of the late Francis Amory, The American Academy of Arts and Sciences, as trustee of a fund given by the testator, announces a prize to be known as "The Francis Amory Septennial Prize" to be awarded for conspicuously meritorious work performed during the immediately preceding septennial period, "through experiment, study or otherwise, in the treatment and cure of diseases and derangement of the human sexual generative organs in general, and more especially for the cure, prevention or relief of the retention of urine, cystitis, prostatis, etc." While the donor wished especially to reward the discovery of any new method of treatment, he expressly authorized that the prize might be given to any author who might have contributed any theoretical or practical treatise of extraordinary or exceptional value and merit on the anatomy of said organs or the treatment of their diseases.

If there shall appear work of a quality to warrant it, the first award will be made in 1940. The total amount will exceed $10,000, which may be divided at the discretion of the academy among several nominees. While formal nominations are not expected and no essays or treatises in direct competition for the prize are desired, the committee invites suggestions looking toward the wise performance of their duty. Communications on this subject should reach the committee not later than May 15, 1940, and should be addressed in care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., U. S. A. The members of the committee on the Francis Amory Septennial Prize are: Dr. Roger I. Lee, *chairman;* Dr. Walter B. Cannon, Dr. David Cheever, Professor Leigh Hoadley, Dr. William C. Quinby, Dr. E. E. Tyzzer and Dr. Soma Weiss, secretary.

A ZOOLOGICAL EXPEDITION OF THE FIELD MUSEUM

A ZOOLOGICAL expedition of the Field Museum of Natural History, sponsored and personally led by Leon Mandel, of Chicago, will sail from Havana in January on Mr. Mandel's yacht *Buccaneer* for a cruise to out-of-the-way cays, islands and rocks in the Caribbean Sea. Birds, mammals and reptiles will be collected, and fishes and other marine creatures will be sought in the surrounding waters. The scientific staff of the expedition plans also to make ecological studies of several species in the exotic fauna of the tropic American region to be visited. This is the fourth expedition Mr. Mandel has conducted for the museum. Rudyerd Boulton, curator of birds, and D. Dwight Davis, assistant curator of anatomy and osteology, who will accompany the expedition, have left for Havana. Mr. Mandel will also take an active part in the collecting, and another collector will be Captain William Gray, of Palm Beach. Mr. Boulton will concentrate his efforts chiefly on birds, and Mr. Davis will specialize in reptiles. Both will also seek desirable specimens of mammals and of oceanographic material, and will assist Mr. Mandel and Captain Gray in the collecting of fishes. Other members of the party include Mrs. Mandel and her mother, Senora Elvira Panerai.

Included in the itinerary are such places as Swan Island, a small possession of the United States; the Bay Islands, which belong to the republic of Honduras; Glover's Reef, Half Moon Cay, Turneffe Cay, Chinchorro Bank, Cozumel Island, Holbox Island and the Triangles—three large rocks in the Gulf of Mexico. The ship will also call at the Mexican port of Progreso, at which time a trip inland will be made to Yucatan's famous Maya archeological site at Chichen Itza. The expedition is expected to complete its work and return to Havana about the middle of February.

Among the objectives of the expedition is the collection of various specimens needed for a new hall of fishes in preparation at the museum. Efforts will be made to harpoon a large devilfish, a species of ray known as manta, which has a fin spread of twelve feet or more in fully developed individuals. An especially equipped fishing launch will be used for work in waters not navigable by the larger vessel. Two-way radio-telephone communication will be maintained be-

tween ship and launch. Specimens will be sought of large game fishes such as marlin, and attempts will be made to study their life history.

Many of the islands and cays to be visited have been incompletely explored biologically. Some of them are known to be inhabited by species and sub-species of birds and reptiles different from those of the adjacent mainland, and it is hoped that the expedition may be able to contribute to the further knowledge of an area which is of special interest to science.

SOIL CONSERVATION

DR. W. C. LOWDERMILK, assistant chief of the Soil Conservation Service, has recently returned from an extended survey of the experience of older countries in the use of land as it relates to soil erosion, soil and water conservation and torrential flood control. His studies took him into Europe, including Great Britain, Holland, France, Italy, Algeria, Tunisia, Lybia, Egypt, Palestine, Trans-Jordan, Syria, Iraq and Lebanon. The war interrupted the course of the survey, which was to have continued through Turkey, Bulgaria, southern Germany and Switzerland and return.

The survey was made in overland travel by auto, including nearly 27,000 miles. It included conferences with more than 120 scientists, agriculturists and government officials, the examination and study of 124 areas of special interest, the collection of soil samples, particularly profiles dated by archeological evidence and the taking of some 3,500 illustrative photographs. Of special interest to American agriculture are evidences of an advanced degree of refinement in measures to control and conserve storm waters and to control erosion of a productive agriculture during the Roman epoch 2,000 years ago in Northern Africa and in ancient Syria. After the destruction of the Roman civilization and the traditions of agriculture by conquering nomad peoples, former measures of water and erosion control fell into disuse and were broken down. Soil erosion then began its damaging work and throughout this area has generally washed off soils from the slopes, sorting erosional débris and carrying the finer fractions out to the sea and spreading the coarser fractions over old alluvium on the valley floors. Increased torrential run-off from the bared slopes produces torrential streams, and is cutting gullies through the alluvium of the valley floors. This in short is the predominant process at work in the old lands south and east of the Mediterranean Sea, except in the broad alluvial plains of the Nile and Mesopotamia. Agricultural possibilities of to-day are restricted principally to the alluvium of lodged soils in the valley floors and outwash plains and in the improved management of vast grazing areas, where drought and famine have been the chief controls. It is possible to reforest the hill and mountain lands in Algeria, in Palestine and Syria, particularly where the country rock is limestone and to restore or to improve the productivity and prosperity of these wasted areas.

THE MINNEAPOLIS MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA AND ASSOCIATED SOCIETIES

THE Geological Society of America is meeting this week in Minneapolis. Many sections of the United States and Canada are represented, and the attendance was expected to reach five hundred. The principal universities, colleges, state and federal geological surveys of Canada and the United States planned to send delegates. Three associated societies—the Paleontological Society, the Mineralogical Society and the Society of Economic Geologists are meeting in conjunction with the Geological Society.

According to the preliminary program Dr. T. Wayland Vaughan, of Washington, D. C., president of the Geological Society, gave the address of the president on Thursday, December 28. His subject was "The Ecology of Modern Marine Organisms with Reference to Paleogeography." Earlier on Thursday Professor R. W. Chaney, of the University of California at Berkeley, retiring president of the Paleontological Society, addressed the several societies on "Tertiary Forests and Continental History." The title of the address of Professor E. S. Moore, of the University of Toronto, retiring president of the Society of Economic Geologists, was "Genetic Relations of Gold Deposits and Igneous Rocks in the Canadian Shield."

A general meeting of the four societies was held on Thursday morning. In the afternoon the sessions of the Geological Society were devoted to a discussion of structural geology; of the Paleontological Society to a discussion of new fossils; and of the Mineralogical Society to a discussion of crystal structure and textures. Papers read before the Economic Geologists were concerned with ground water supply and other applications of geology to the field of non-metallic resources. The technical sessions of the different societies were continued on Friday. On that day, in addition to the general session of the Geological Society, two joint sessions were held, one with the Paleontologists and one with the Mineralogists and Economic Geologists. Technical sessions were planned for Saturday morning, after which the meeting will close with an open house and tea at the Pillsbury Hall of the University of Minnesota.

OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

DR. WILLIAM LLOYD EVANS, head of the department of chemistry of the Ohio State University, has been elected president of the American Chemical Society for 1941. He will take office as president-elect on January

1, at which time Dr. Samuel Colville Lind, dean of the Institute of Technology of the University of Minnesota, becomes president, succeeding Professor Charles A. Kraus, of Brown University.

The president-elect was chosen by the council of the society from four nominees receiving the largest number of votes in a national poll by mail of the 24,000 members of the society. The council includes national officers, directors, editors of the publications of the society, past presidents, chairmen of eighteen professional divisions and councilors of the ninety-two local sections.

Other elections were:

Directors: Dr. Elmer K. Bolton, chemical director of E. I. du Pont de Nemours and Company, Wilmington, Del., *director-at-large.*

Leason H. Adams, director of the Geophysical Laboratory of the Carnegie Institution, for the fourth district of the society, comprising Alabama, Arkansas, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia.

Dr. Robert E. Swain, head of the department of chemistry at Stanford University, reelected for the sixth district, including Arizona, California, Colorado, Idaho, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming, Alaska and Hawaii.

Councilors-at-large: Dr. Per K. Frolich, director of the chemical laboratories of the Standard Oil Development Company, Elizabeth, N. J.; Dr. Edward Mack, Jr., of the Battelle Memorial Institute, Columbus; Dr. C. E. K. Mees, vice-president in charge of research and development of the Eastman Kodak Company; Professor William A. Noyes, Jr., of the University of Rochester, New York.

Professor Evans, who received the William H. Nichols Medal of the New York Section of the society in 1929 for his work on the chemistry of carbohydrates, has been a member of the faculty of the Ohio State University for thirty-five years and has been chairman of the department of chemistry since 1928. From 1892 to 1894 he was chemist of the American Encaustic Tile Company, Zanesville, Ohio. He served as assistant in the department of ceramics at the Ohio State University from 1896 to 1898, and instructor in the Colorado Springs High School from 1898 to 1902. He became assistant professor of chemistry at the Ohio State University in 1905, associate professor in 1908 and full professor in 1911.

SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science and some thirty of its associated and affiliated societies are meeting this week at Columbus. The address of the president, Professor Wesley C. Mitchell, is printed in the present issue of SCIENCE. This will be followed by other addresses of special interest. A general report of the meeting, edited by the permanent secretary, will be printed in the issue for February 2.

DR. ALEXANDER WETMORE, assistant secretary of the Smithsonian Institution, has been elected a corresponding member of the Royal Australasian Ornithologists' Union.

IT is stated in *Nature* that Dr. Gerhard Domagk, who was recently awarded the Nobel Prize for Physiology and Medicine for 1939, has been elected an honorary member of the Pharmaceutical Association of the Hindu University of Benares.

DECORATIONS of the Chinese Order of the Jade were presented on December 20 at a reception in New York City to Dr. John Dewey, professor emeritus of philosophy of Columbia University, in recognition of his work for Chinese students, and to Dr. Nicholas Murray Butler, president of Columbia University. The presentations were made by Dr. Tsune-chi Yu, Chinese Consul-General in New York.

PHILIP TORCHIO, who retired in 1938, at the age of seventy years, from the position of vice-president of the Consolidated Edison Company of New York, Inc., has been awarded the Edison Medal for 1939 of the American Institute of Electrical Engineers in recognition of "distinguished contributions to the art of central station engineering and for achievement in the production, distribution and utilization of electrical energy." The presentation will be made on the evening of January 24 during the winter convention of the institute, which will be held in the Engineering Societies Building, New York.

E. MEAD JOHNSON awards of $500 each were presented by the American Academy of Pediatrics at its annual meeting in Cincinnati to Dr. Frederic A. Gibbs, instructor in neurology, Harvard Medical School, and Dr. Dorothy H. Andersen, New York. The award was made to Dr. Gibbs in recognition of his work on epilepsy and to Dr. Andersen for her work on pancreatic disorders.

E. R. SQUIBB AND SONS have established an annual award of $1,000 to encourage investigation in endocrinology. The administration of this award has been intrusted to the Association for the Study of Internal Secretions, of which Dr. Philip E. Smith is president. Dr. Edward A. Doisy is chairman of the Committee on Awards. Nominations for the 1940 award must be received before March 1 by the secretary of the so-

ciety, E. K. Shelton, 921 Westwood Boulevard, Los Angeles, Calif.

DR. T. L. ALTHAUSEN, associate professor of medicine in the Medical School of the University of California, has been awarded the Van Meter Prize of the American Association for the Study of Goiter in recognition of his work on the thyroid gland.

THE president of the University of Cincinnati and the faculty of the College of Medicine sponsored a dinner on December 6 at the Netherland Plaza Hotel, Cincinnati, in honor of Dr. Albert H. Freiberg, who recently retired as professor of orthopedic surgery. Dr. Martin H. Fischer was toastmaster, and the speakers were Dr. Raymond Walters, president of the university; Drs. Stanley E. Dorst, Mont R. Reid and David I. Wolfstein, and the Rev. Jesse Halsey, pastor of the Seventh Presbyterian Church. A portrait of Dr. Freiberg was presented to him.

DR. HORACE B. ENGLISH, professor of psychology of the Ohio State University, was elected president of the Association of Applied Psychologists at the recent Washington meeting of the association.

THE thirty-second annual meeting of the American Society of Agronomy and the fourth annual meeting of the Soil Science Society of America were held in the Roosevelt Hotel, New Orleans, on November 22, 23 and 24, with an attendance of approximately seven hundred. During the session a hundred and seventy-seven papers on various phases of soils and crops problems were presented. At a general meeting W. C. Lasseter, editor of the *Progressive Farmer,* spoke on "The Social and Economic Problems of Southern Agriculture" and Dean M. J. Funchess, dean of agriculture at the Alabama Polytechnic Institute, discussed "Agronomic Problems of the South." Officers of the American Society of Agronomy elected for 1940 are: *President,* Dr. F. J. Alway, University of Minnesota; *Vice-president,* Dr. L. E. Kirk, Central Experimental Farm, Ottawa; *Secretary-Treasurer,* Dr. G. G. Pohlman, West Virginia University; *Editor,* J. D. Luckett, New York Agricultural Experiment Station, Geneva; *Chairman of Soils Section,* Dr. W. H. Pierre, Iowa State College; *Chairman of Crops Section,* Dr. S. C. Salmon, Bureau of Plant Industry. Officers of the Soil Science Society of America for 1940 are: *President,* Dr. W. H. Pierre, Iowa State College; *Secretary,* Dr. C. E. Kellogg, Bureau of Plant Industry; *Treasurer,* Dr. G. G. Pohlman, West Virginia University.

PROFESSOR HENRI DARWIN HASKINS, for nearly fifty years a member of the faculty of the Massachusetts State College and more recently chief of the laboratory for fertilizer control, having reached the state retirement age of seventy years, the title of emeritus professor of agricultural chemistry has been conferred on him.

THE title emeritus has been conferred by the University of Missouri on Sidney Calvert, who retired in September as professor of organic chemistry and director of the chemical laboratory.

NEW appointments at the New York Medical College include: Dr. Ferdinand C. Lee, associate professor of surgery at the Johns Hopkins University, as professor and head of the department of surgery and dean of the college; Dr. Thomas I. Hoen, of Montreal, as professor of neuro-surgery and head of the department of neuro-surgery and neuropsychiatry; Dr. R. Townley Paton, surgeon of the Manhattan Eye, Ear and Throat Hospital, as professor and head of the department of ophthalmology, and Dr. William H. Everts, of the Neurological Institute of New York, as professor of neurology.

DR. ARTHUR SULLIVAN GALE has resigned as dean of the College for Men at the University of Rochester, effective on January 1. Dr. W. Edwin Van de Walle, professor of philosophy and chairman of the Committee on Advice, will succeed him. Dr. Gale will continue as Fayerweather professor and chairman of the department of mathematics, a post that he has held since 1906.

DR. JOSEPH MURDOCH has been appointed associate professor of geology at the University of California at Los Angeles, where he has taught since 1928.

DR. TZE-TUAN CHEN, a research fellow in the department of zoology of the Johns Hopkins University, has been appointed research associate in protozoology in the School of Hygiene and Public Health.

DR. BIENVENIDO M. GONZALEZ, who for the past twelve years has been dean and head of the department of animal husbandry of the College of Agriculture, University of the Philippines, was formally inaugurated as president of the university on October 19. President Gonzalez is succeeded by Dr. Leopoldo B. Uichanco as dean of the College of Agriculture. Dr. Uichanco continues to be head of the department of entomology.

DR. JUAN BACIGALUPO has been appointed professor of parasitology in the Faculty of Medicine at Buenos Aires to succeed Dr. D. Greenway, who has reached the age limit.

DR. R. Y. WINTERS has been appointed assistant director of research in the Department of Agriculture. He has been a staff member of the Office of Experiment Stations since 1937.

DR. K. A. C. ELLIOTT has been appointed research biochemist at the Institute of the Pennsylvania Hospital, Philadelphia, which is initiating a new program of research in mental and nervous diseases. Dr. Elliott will be in charge of the laboratory.

ALBERT C. CLINE, who has been on the staff of the

Harvard Forest in Petersham, Mass., since 1924, has been appointed director of the forest. He succeeds Ward Shepard, who was director for three years while on leave of absence from the Federal Government, but who has now returned to Washington.

A UNIVERSITY Committee on Pharmacotherapy has been formed at Harvard University. The function of the committee will be to coordinate the efforts of practising physicians and the members of the faculty in biology, chemistry and medicine and to develop research and improved graduate training in pharmacology and experimental therapeutics. In carrying out this program, the committee will bring together chemists and biologists from the Harvard Faculty of Arts and Sciences, pharmacologists, physiologists and biochemists from the Harvard Medical School, and physicians working with patients in hospitals. Dr. Soma Weiss, Hersey professor of the theory and practice of physic at the Medical School, is chairman of the new committee. The other members are: Dr. Fuller Albright, assistant professor of medicine; Dr. Henry K. Beecher, associate in anesthesia; Dean Burwell, *ex-officio;* Dr. Walter B. Cannon, George Higginson professor of physiology; Dr. William B. Castle, professor of medicine; President Conant, *ex-officio;* Dr. Louis F. Fieser, professor of chemistry; Dr. A. Baird Hastings, Hamilton Kuhn professor of biological chemistry; Dr. Frederick L. Hisaw, professor of zoology; Dr. Otto Krayer, associate professor of comparative pharmacology, and Dr. Reginald P. Linstead, professor of chemistry. Funds to support the work for the next five years have been donated by a group of corporations interested in medical and therapeutic research.

THE Wilson photoalidade, that was designed and built in the U. S. Geological Survey several years ago, will be used again this winter by T. W. Ranta in the office-mapping of part of the north slope of the rugged Wrangell Mountains, Alaska, from oblique airplane photographs. Mr. Ranta established the necessary ground control during the recent field season and will use photographs taken by Gerald Fitzgerald, of the Geological Survey, and Bradford Washburn, of the Harvard Institute of Geographical Exploration.

DR. JULIAN A. STEYERMARK, assistant curator of the herbarium of the Field Museum, Chicago, who is conducting an expedition in Guatemala, has during the first month collected specimens of more than a thousand varieties of plants. In the course of his exploration he climbed to the summit of the Sierra de las Minas, which rises above the Motagua River, a region probably never before visited by a botanist. He has also collected the flora of the Motagua Valley desert region of the Atlantic watershed. Dr. Francis Drouet, curator of cryptogamic botany, who with Donald Richards, of the University of Chicago, is collecting in the southwestern United States and northwestern Mexico, has forwarded to the museum a collection of 1,200 algae and other plants from the general region of Las Vegas. N. M.

DR. G. H. PARKER, of Harvard University, lectured on December 18 at an open meeting of the Brown University Chapter of Sigma Xi on the question, "Is Natural Selection a Brutal Process?"

A SERIES of eight lectures at Yale University on the history of science is planned by the Yale Chapter of the Gamma Alpha Graduate Scientific Fraternity. The first seven lectures will trace the history of the basic sciences. The last one will deal with the development of medicine in relation to the other sciences. The program includes lectures by the following members of the faculty of the university: January 16, *Astronomy,* by Dr. Frank Schlesinger; January 30, *Mathematics,* by Dr. Oystein Ore; February 13, *Geology,* by Dr. Chester R. Longwell; February 27, *Chemistry,* by Dr. John A. Timm; March 12, *Physics,* by Dr. Henry Margenau; April 2, *Biology,* by Dr. Lorande L. Woodruff; April 16, *Psychology,* by Dr. Walter R. Miles; April 30, *Medicine and the Sciences,* by Dr. John F. Fulton. Until the time of his death the late Dr. Harvey Cushing was collaborating with Dr. Fulton on the last lecture. In general the plan and scope of the series is similar to the series presented by the fraternity in 1920. Two new subjects, Psychology, and Medicine and the Sciences, have been added.

THE fifth International Congress of Pediatrics, which was to have been held in Boston in September, 1940, has been postponed to an indefinite date. Dr. Henry F. Helmholz, Rochester, Minn., is president of the congress; Dr. Kenneth D. Blackfan, Boston, general secretary, and Dr. Charles F. McKhann, Boston, assistant secretary.

THE new building of the New York Medical College, Flower and Fifth Avenue Hospitals, erected at a cost of $1,500,000, was dedicated on December 12. The speakers included Mayor La Guardia, President Harold Willis Dodds, of Princeton University; Dr. Lewis Hill Weed, director of the School of Medicine of the Johns Hopkins University, and Charles D. Halsey, chairman of the board of trustees. Dr. Claude A. Burrett, president of the college, presided.

BEQUESTS of about $1,500,000 to Northwestern University and $1,000,000 to the University of Chicago for medical and chemical research are provided in the will of Mrs. Clara A. Abbott, who died in 1924. She was the widow of Dr. Wallace C. Abbott, founder of the Abbott Laboratories of North Chicago. The gift to the University of Chicago makes the institution eligible for an additional $1,500,000 grant, given by the Rockefeller Foundation for Research in the bio-

gical sciences, with the proviso that the university ise an additional $500,000 for that purpose.

THE Ruth Lucie Stern Research Laboratory, the ift of Mrs. Louis Stern, built at the cost of about 7,000, has been opened at the School of Medicine Stanford University at San Francisco. It is three ories high and has more than 6,000 feet of laborary space. The second floor is occupied by research pediatrics and the top floor by research in pathogical gynecology, endocrinology and cancer.

ERNEST L. WOODWARD has made a gift of $45,000 the University of Rochester to support the research epilepsy of Dr. W. P. Van Wagenen, associate rofessor of neurological surgery at the School of edicine and Dentistry. The facilities of the Craig olony for Epileptics, at Sonyea, and of the Roches- State Hospital have been extended to him during e past year. Previous support of the work had me from the Markle Foundation.

THE will of Charles R. Walgreen, founder of the Walgreen drug store chain, who died on December 11, provides for the transfer of the balance of the 19,000 shares of the stock he had pledged previously to the University of Chicago.

LORD NUFFIELD has placed in the hands of trustees ordinary shares of Morris Motors, Limited, worth approximately £1,250,000, to be the nucleus of a fund for the provinces to finance a scheme of hospital regionalization.

THERE will be available on September 1, 1940, a research fellowship in the laboratory of pathology at the Collis P. Huntington Memorial Hospital and in the Department of Pathology at the Harvard Medical School. This carries a stipend of three thousand dollars and may be renewed for a second year. The fellow will be expected to devote most of his time to histologic and cytologic studies of the effects of radiation of different types on normal and pathological tissue. Application should be made to Dr. Shields Warren at the Collis P. Huntington Memorial Hospital, Boston.

DISCUSSION

RADIOACTIVITY IN BIOLOGICAL EXPERIMENTS

THE successful production of radioactive materials a cyclotron has led to interesting biological experients in which these substances are used as tracers. this new field many results have already been tained, some of which are in disagreement with preously held opinions. This has given rise to the funmental question of whether a radioactive element s the same properties as the element in its normal rm.

Radioactivity. This question is unfortunately sometes the result of a misunderstanding of the nature radioactivity. It is sometimes erroneously believed at radioactive atoms continually emit radiations. A dioactive atom does not emit any radiation at all til the very end of its existence, when it changes into nother element. The tracer experiments involve only oms which have not yet radiated. It is clear that ture emission of such radiations can not have any fluence upon the present atomic properties.

Atomic Weight. The radioactive atoms have an omic weight slightly different from normal atoms. his can have an effect upon some of their properties uch as the rate at which they diffuse through a membrane. However, effects of this kind are well known be exceedingly small and barely observable even in pecially designed physical experiments.

Normal elements also consist generally of a mixture atoms of different atomic weights, called isotopes. There is some evidence[1] that the mixture has a slightly different composition when taken from different parts of the animal system. This difference is very small, showing clearly that living tissue does not possess a pronounced ability to distinguish between isotopes. It is obvious that such minute effects need only be considered after the quantitative accuracy of the tracer experiments has been very much improved.

Presence of Radiation. A fraction of the tracer atoms will emit radiations during the progress of the biological experiment. Though such atoms lose their rôle as tracer, one may ask whether the presence of this radiation does not alter the properties of the living organism and influences the result of the tracer experiment. In these experiments the radioactive element is so greatly diluted and the radiation so weak that such an effect seems very unlikely. The following simple observation can verify this in doubtful cases. If the result of the tracer experiment were due to the presence of the radiation, the yield of the experiment should be approximately proportional to the *square* of the amount of tracer administered instead of in direct proportion to it.

In this connection it is also interesting to examine Zwaardemaker's well-known hypothesis that the radioactivity of potassium is responsible for its physiologi-

[1] A. Keith Brewer (*Jour. Am. Chem. Soc.*, 58: 869, 1937) finds that the potassium in bone marrow consists for about 6.75 per cent. of the isotope of atomic weight 41; in other organic and inorganic sources the percentage is 6.58 per cent.

cal action. The basic experiment to support this idea is the beating of an isolated frog's heart when perfused with a certain solution of a mixture of salts, one of which has to be potassium chloride. The amount of potassium in this solution is so small that a simple calculation indicates that only about one potassium atom per hour radiates in the frog's heart. Since the whole experiment can be performed in a much shorter time, it is absurd to connect in this experiment the necessary presence of potassium with its radioactivity.[2]

Conclusion. The above remarks are meant to show that tracer experiments with radioactive elements, if carefully executed, give definitely reliable information about the behavior of the normal element. If unexpected results are found they should certainly not be ascribed to a difference in the properties of the radioactive isotope.

S. GOUDSMIT

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PSEUDOMETHEMOGLOBIN AND ITS REACTION WITH CARBON MONOXIDE AFTER REDUCTION

IN a discussion in this journal[1] recently, E. Ammundsen published her observations on the presence in the blood of "a kind of hemoglobin" combining with carbon monoxide only after reduction. With reference to that substance the author emphasizes that "for the present its composition and the cause of its appearance will have to be looked upon as unknown." In this connection the following facts may be of interest.

The normal presence of substances in human and animal blood not identical with hemoglobin but combining with carbon monoxide in a similar way was described by Barkan and Berger[2] in 1928. These authors pointed out that of the "easily split-off" blood iron ("leicht abspaltbares" Bluteisen) discovered by Barkan[3] (1925) one portion E combines with O_2 and CO following the distribution equation, while another portion E′ does not react with those gases. In 1937 we[4] demonstrated that both fractions of the "easily split off" blood iron are pseudohemoglobins which are intermediates in the formation of bilirubin from hemoglobin and accompany the hemoglobin within the r cells of the circulating blood. Pseudohemoglobins, a cording to our definition, are chromoproteins in whi the protein is probably an unaltered globin, while t prosthetic group is an iron-containing heme or hem derivative with an opened porphyrin ring, similar that in Lemberg's[5] "verdohemochromogen." The t fractions E and E′ differ by the valency of the iro The latter is bivalent in *E*, which combines with oxyg and carbon monoxide and hence was designated as pseudohemoglobin *in sensu strictiori*. The iron is t valent in E′, which does not combine with O_2 and C and was designated as a "pseudomethemoglobin." B reduction with $Na_2S_2O_4$ we were able to transform t pseudomethemoglobin into pseudohemoglobin, whi does combine with carbon monoxide.

Our work was published in different original a ticles[4-6] and, in addition, some reviews[7] have be given. Taylor and Coryell[8] in an article (1938) dea ing with the magnetic susceptibility of the iron i ferrohemoglobin confirmed our work. Using the sa method as was later used by E. Ammundsen,[1] th found too that in normal blood and in oxyhemoglob solutions there are present hemoglobin-like compoun which combine with carbon monoxide only after pr vious reduction.

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OTTO SCHALES

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AN EXPERIMENT ON RETINAL AFTER-IMAGE AND JUDGMENT OF SIZE

BY an almost unconscious combination of elemen we judge the size of an object from the image it pr duces on the retina and from our judgment of its di tance from the eye. If there is uncertainty in th latter judgment, there is corresponding uncertain in judgment of size because we do not then know ho far away to consider the object to be and do not kno how to interpret the retinal image. It is comm experience that we are incapable of estimating th

[2] A. J. Glazko and D. M. Greenberg (*Am. Jour. of Physiol.*, 125: 405, 1939) have shown that radioactive sodium can not replace the potassium in this experiment. Compare also a critical article by S. G. Zondek, *Biochem. Zeits.*, 121: 76, 1921.

[1] SCIENCE, 90: 2338, 372–373, October 20, 1939.

[2] G. Barkan and E. Berger, *Arch. exp. Pathol. u. Pharmakol.*, 136: 278–299, 1928; *Klin. Wochenschr.*, 7: 1868, 1929.

[3] G. Barkan, *Zeits. physiol. Chem.*, 148: 124–154, 1925; *ibid.*, 171: 179–193 and 194–221, 1927; *Biochem. Zeits.*, 224: 53–62, 1930; *Zeits. physiol. Chem.*, 216: 1–16 and 17–25, 1933; *ibid.*, 221: 241–251, 1933; *ibid.*, 236: 198–200, 1935. See also G. Barkan and O. Schales, *ibid.*, 244: 81–88, 1936; *ibid.*, 244: 257–265, 1936.

[4] G. Barkan and O. Schales, *Zeits. physiol. Chem.*, 248: 96–116, 1937.

[5] *Cf.* R. Lemberg, *Ann. Rev. Biochem.*, 7: 421–4 1938; and original papers cited therein.

[6] G. Barkan and O. Schales, *Zeits. physiol. Chem.*, 25 83–103, 1938.

[7] G. Barkan, Lecture in the Wiener Biologische Gese schaft, June 14, 1937; *Klin. Wochenschr.*, 16: 126 1268, 1937; *Dtsch. Mediz. Wochenschr.*, 64: 638–6 1938; Kongressbericht II des XVI Internat. Physiol. Kon gresses, Zürich (Schweiz), 1938, p. 250; G. Barkan an O. Schales, *Arch. Ital. di Sc. Farmacologiche*, Vol. Juli ad Benedicenti, 1937; O. Schales, Research Meeting of th Rockefeller Institute, Copenhagen, December 3, 1938.

[8] D. S. Taylor and Ch. D. Coryell, *Jour. Am. Chem. Soc.* 60: 1177–1181, 1938.

ze of the moon, for example, because, although we eceive a clear image which subtends a certain angle, e receive no accompanying sense experience which ight enable us to judge the distance of the object. Astronomically determined distances are not, of urse, perceived directly.) Elementary observations optics show that whenever a real image is formed a lens, as in the case of images formed on the retina the lens of the eye, the size of the image decreases the distance between lens and object increases. We arn in infancy to interpret this relationship between age size and distance of object. The following para-aphs describe a simple experiment which is, in a nse, the converse of our common experience with tinal images.

It is well known that exposure of the eye to bright ht produces retinal fatigue and that after one has zed intently for several seconds at a bright source, ere may appear an after-image of the source soon ter the eyes are shifted to some less brightly illumi-ted area. This after-image is commonly seen in a lor complementary to that of the source, a fact hich has heretofore played a part in hypotheses of lor-vision, but which is, for the present, of secondary portance. It is the *size* of the after-image rather an its color to which the writer wishes to direct tention; for this persistent image may be used to oduce the illusion of an external object whose appar-t distance from the eye may be varied at will, with e result that the illusory "object" changes size, and s apparent size depends entirely upon the observer's dgment of its distance from the eye.

Let the observer, with one eye closed, look with the her eye steadily for ten seconds upon the bright ament of an unfrosted 60-watt lamp situated, say, o feet from the eye. If the gaze is then shifted some less bright region, there soon appears a pro-unced after-image of the lamp filament which may rsist clearly for a minute or two because of the tigue of that portion of the retina which has been strongly exposed to light. If the observer has diffi-lty in discovering the after-image, it may be "devel-ped" or made more apparent by blinking the exposed e occasionally or by exposing it indirectly to inter-ittent flashing of a low-power lamp (15 or 25 watt). nce the image is seen, it may be followed from spot spot about the room as the observer shifts his gaze; may appear as a large object on a distant wall or as small object on a piece of paper held close at hand. he change in apparent size of the illusory object immediately evident; it is amusing, for example, to ix" the object on a finger tip held not far from the e and to observe the increase in its apparent size the finger is moved farther away. By observing he after-image on a scale and by recording its appar-ent size as a function of the observer's distance from the scale, it is possible to check with reasonable accuracy that this apparent size of object is directly proportional to the distance between the eye and the scale on which the after-image appears to be situated.

Because of the well-known phenomenon of irradiation and because of involuntary movements of the eye during exposure to the light, the after-image on the retina is somewhat extended and looks larger than the lamp filament. However, the horseshoe-shaped filament of a 60-watt lamp gives an image which is readily recognized and is sufficiently definite in outline to serve for measurement. A frosted lamp may be used if it is obscured from view except for a small aperture of sharp outline and characteristic shape. The color of the after-image is not always the same but appears to depend upon length of exposure and upon external illumination. It may, at first, be dark blue (roughly complementary to the bright yellow of the source); but in many cases, especially under periodically changing illumination, it may change from dark blue to bright yellow, and by this reversal of color the after-image may be easily detected. In many cases it appears as a bright yellow object like the lamp filament, but with a blue border. When this experiment was tried with a group of twenty students at once, it was found that nearly all of them observed the effects described herein. The experiment may serve to demonstrate to students of physics and psychology certain fundamental facts of vision by the simple expedient of using a strong retinal after-image for purposes of measurement and observation. It is recognized that there may be danger to the eye in prolonged exposure to an intense source of light, but the writer has personally repeated the experiment a great many times without any observed harmful effects.

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THE OCCURRENCE OF THE TWO RARE GENERA, PROTOHYDRA AND PROTODRILUS, ON THE EAST COAST OF NORTH AMERICA

THESE two genera, so far as can be ascertained, have never before been reported from the North American continent. The first form, *Protohydra leuckarti*, probably represents the most primitive coelenterate of the class Hydrozoa. It was found in a small brackish water creek formed at low tide on the mud flats in New Haven harbor together with numerous Protozoa, rotifers and Turbellaria. Only one specimen was found which after several hours' isolation divided by transverse fission. The two individuals thus formed lived for several weeks in the laboratory, when for some unaccountable reason they disintegrated over night. The animals, which lack tentacles, feed on small

crustacea, rotifers and protozoa, which they capture by means of the expanded spoon-shaped peristome. Although discovered by Greeff in 1870 in Europe, the animal has been collected only occasionally since that time and consequently practically no experimental work has been done upon it. Recently, chiefly through the work of Westblad,[1] the sexual reproduction has been studied, and the extremely interesting observation made that the sex cells are of endodermal origin with the ovaries and testes projecting into the enteric cavity. Only two species are known, *P. leuckarti* Greeff and *P. caulleryi* Dawydoff.

The second animal, *Protodrilus leuckarti* Hatcheck, was collected by Mr. D. J. Zinn, of the Osborn Zoological Laboratory, from intertidae sand near Branford, Conn. Although some eleven species of this archiannelid genus have been reported from Europe, th far none has been found in North America, chiefly, it believed, because of failure to collect from its habit As is the case with *Protohydra,* little experiment work has been performed upon this form because its comparative rarity. Very likely large numbers European invertebrate genera are present here and w be discovered when our coasts are studied more inte sively.

Both *Protohydra* and *Protodrilus,* it is believed, off excellent possibilities for experimental work if the can be collected in more abundance and maintained culture.

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SCIENTIFIC BOOKS

THE TEACHERS OF PHYSICS

WE have probably all listened to a teacher explain in glowing colors his way of teaching physics and have had the feeling that we should rush home and introduce his system into our classrooms. Closer thought, however, shows us that we have been listening to a happy, competent, enthusiastic teacher who has successfully fitted his teaching to his school, his students and his own personality. This same system forced on an overworked, less competent and unsympathetic teacher or a group of students of different training and point of view might well fail even worse than the system now being used. It seems that the same reasoning must be applied to text-books.

Probably most teachers are a bit dissatisfied with the text they are using. If only we could inject into the first-year student some of the enthusiasm of many graduate students, then our work would be made more easy. The advanced student is out on the front of new advances and new discoveries. Then should not these same "newest" ideas be made the theme of elementary texts? Some writers of text-books think so.

Smyth and Ufford (S & U)[1] is a text with this theme of "newness." The whole treatment is novel and new. The writers have not omitted the fundamental laws but rather have caused them to be brightened by the light of the advances of recent years. They are among the first writers of general texts to introduce and use the long recommended K.M.S. system of units with the Newton ($=10^7$ dynes) as the unit of force. This factor alone will doubtless influence some teachers in favor and some against this text. It would hardly be possible for the teacher to cling to the C.G.S. system and use this text.

In the hands of an experienced teacher who ca keep in mind that good foundations are still necessar for safe construction and who nevertheless is willin to follow the spirit of the book S & U should be real experience to the beginning college student. O the other hand, the inexperienced teacher who permi enthusiasm for the new to cause him to forget the ne essary fundamentals or the teacher who puts this te into the hands of his student and then tries to teac in the conventional manner will produce neither goo physicists nor clear thinkers.

Housman and Slack (H & S)[2] have avoided som of these dangers by writing a more conventional te with the material arranged as we are accustomed t find it, and yet they have included nearly every bit o new physics that S & U have used and some besides A text which includes the "fission of uranium" an "non-reflecting glass," as does the H & S text, ca hardly be called old-fashioned, yet these authors hav kept their emphasis on teaching the fundamentals t the beginning student, to whom all physics is new. I their greater emphasis on fundamentals they hav taken particular care to get the subject of units clea and straight in the student's minds. Also they hav been careful to keep fundamental statements and defi nitions from becoming lost within long paragraphs o explanation.

There was some criticism on the part of teacher using H & S that the first edition showed a lack o care in the latter chapters compared to the earlie ones, as if the authors had been hurried to finish thei task. This defect seems to have been eliminated com pletely in this second edition.

Both of these texts recognize that too many college students are poorly prepared in the art of working

[1] E. Westblad, *Arkiv för Zoologi,* 21A, No. 23.

[1] Smyth and Ufford, "Matter, Motion and Electricity." McGraw-Hill Book Co. $3.75.

[2] Housman and Slack, "Physics." Second edition. D Van Nostrand Co. $4.00.

numerical problems and getting correct numerical answers. Hence they include a considerable number of carefully and completely worked-out numerical problems.

Both of these texts are of a difficulty which suggests their successful use only in the school where the students are rather above the average in ability and preparation. For the less capable students the older, well-tried and now rewritten Stewart[3] is in point of view much like H & S but with more qualitative description, less difficult mathematical discussion and, in general, of a lower level of difficulty but still a college text and not at all a glorified high-school text.

This reviewer feels at one disadvantage in writing of these texts. While these must be classed as among the best of the present texts, there are others which are completely comparable with these and which a teacher should also examine before deciding on the text for his classes.

Since the teaching of second-year electricity has escaped from the domination of Starling's "Electricity and Magnetism," whose red cover cast its controlling influence over this field for so many years, there have appeared a number of electrical texts. One of the newest is "Fundamentals of Electricity and Magnetism," by Loeb.[4]

This book was, according to the author, written to supply a text to accompany a course of twenty-six one-hour demonstration lectures. Hence the material was much influenced by the apparatus and conditions of those lectures. The students were to have had differential calculus before starting electricity and to be taking integral calculus concurrently with their electricity. Hence the first integral sign appears on page 87, following an unusually long historical introduction. The mathematical developments are rather less difficult than is common in such texts.

The author has followed the old convention of starting his development with the concept of a magnetic pole, which in spite of much criticism does seem to have its advantages. Similarly his treatment of B & H is quite conventional and no mention is made of the difficulties which have arisen in this field nor of the dicta of the International Electro-Technical Commission.

In his preface he states that he has found that "the greatest difficulty encountered by the student is the confusion in the definition and relation of the many electrical entities occurring in such a treatment." His definitions of field strength at a point as "the force exerted on a unit North pole at that point" (page 64) and potential difference as the "work to move unit quantity of electricity between those points," hardly agree with the criteria given by Worthing.[5]

There are a number of other minor criticisms which may be mentioned such as an unusual use of the expression "most efficient" on page 167 where it is used to mean "most current"; a strange diagram on page 328 where a damped sine function is plotted by straight lines: the failure to make clear the effect of line resistance in the self-induction experiment.

Where instructors wish a text which lies midway between the electricity of the conventional first year of college physics and the standard senior college course, Loeb's text will be found quite satisfactory and will fill a need in this field where few other texts are available.

A very different book is "The Fundamentals of Electro-Magnetism" by Cullwick.[6]

Professor Cullwick, recognizing that there has been a lack of clear thinking in many elementary texts, has attempted to put clarity and rigor into an elementary text. Mostly he has succeeded but some of his failures help to emphasize the difficulty of his undertaking. He has not produced a senior college text-book but he has produced a book which all teachers in this field should read both for its clarity and also for its confusion.

An elementary physics book[7] has been written by physicists and as nearly without mathematics as possible. No attempt has been made to "jazz up" the subject. Not at all a high-school text but, as the name implies, it is a survey for college students who can't or won't use simple mathematics.

"Mechanics for Engineering Students,"[8] is a text-book containing a very great number of carefully discussed mechanics problems, using only simple calculus. d'Alembert is mentioned, but not Lagrange nor Hamilton. Vectors are treated only by their components and no direct vector notation is used.

"Introduction to Laboratory Technique,"[9] is a book that will be found useful in any laboratory where work is being done. There are formulas and instructions for a great many things which a laboratory or shop man frequently needs to use. Aside from some English trade names and an occasional shop use of a word which will confuse a chemist or physicist, the instructions seem to be very clear and definite.

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[3] O. M. Stewart, "Physics. A Text Book for Colleges." Third edition. Ginn and Company. $4.00. (First edition, 1924.)

[4] Loeb, "Fundamentals of Electricity and Magnetism." John Wiley and Sons. $4.00.

[5] A. G. Worthing, *American Physics Teacher*, 6: 59, 1938.

[6] Cullwick, "The Fundamentals of Electro-Magnetism." Macmillan, $4.50.

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[9] A. J. Ansley, "Introduction to Laboratory Technique." London: Macmillan and Company. $4.50.

SPECIAL ARTICLES

A DEFECT IN THE METABOLISM OF AROMATIC AMINO ACIDS IN PREMATURE INFANTS: THE ROLE OF VITAMIN C[1]

IN the course of studies of the nitrogen metabolism of premature infants, a number of the infants were found to excrete substances in their urine which gave the Million reaction.[2] Further studies demonstrated the absence of appreciable amounts of tyrosine, dihydroxyphenylalanine, homogentisic acid and melanin, thus exempting them as the hydroxyphenyl compounds responsible for the reaction. Dr. Hans Clarke, professor of biochemistry at Columbia University, extracted from these urines crystals of l-p-hydroxyphenyllactic acid, identification being made by elementary analysis, melting point and optical rotation, the urinary substance conforming in all respects to the pure compound. Qualitative tests (a positive but transitory response to dilute ferric chloride, a precipitate with 2, 4-dinitrophenylhydrazine) also established the presence of a keto-acid, probably p-hydroxyphenylpyruvic acid in these urines, but it has not yet been isolated in a pure state. Reduction of phosphomolybdic acid by Medes' technique[3] has been employed for quantitative assay.

Since these substances were absent from the urine of premature infants receiving human milk and since their excretion was enhanced by the feeding of phenylalanine and tyrosine, it seemed reasonable to relate the defect to the higher content of these amino acids in cow's milk. The possibility that this defect in oxidation and decarboxylation of aromatic amino acids above a threshold level of intake might be related to an enzymatic deficiency remediable by administration of vitamins was suggested by the observation of Closs and Fölling[4] that the urinary excretion of phenylpyruvic acid following injection of phenylalanine was increased in rats by deficient intake of vitamin B_1. Such therapy with thiamin chloride in liberal dosage (20 mg daily) had no effect on the spontaneous excretion of hydroxyphenyl compounds in several of the infants. The effect of vitamin C therapy, however, was striking.

Shortly after birth five male premature infants were placed on diets of powdered cow's milk of adequate caloric, fluid and protein (5 gm per kg) content supplemented with vitamin A and D concentrates (20 drops of percomorph oil daily) but without added vitamins B and C. Complete 24-hour urines were quantitatively assayed for hydroxyphenyl derivatives.[5] The infants received from 50 to 200 mg of ascorbic acid parenterally at the ages indicated in Table 1, and in four of the five there resulted a prompt decline with virtual disappearance in excretion of hydroxyphenyl compounds within 48 to 72 hours. In the fifth infant (G. A.) 50 mg was ineffective, but the administration of 100 mg several days later was accompanied by a prompt response. In another infant (G. B.) the cycle of appearance of urinary hydroxyphenyl derivatives with omission of dietary vitamin C and disappearance with its resumption was demonstrated on two occasions. These results gain added interest in view of a recent report relating the production of experimental alcaptonuria to vitamin C deficiency[6] and the demonstration *in vitro* of the relation of dehydroascorbic acid to the breakdown of amino acids, including phenylalanine, to aldehydes.[7]

TABLE 1

THE EFFECT OF VITAMIN C ON THE EXCRETION OF HYDROXYPHENYL COMPOUNDS

Age days	Vitamin C supplement mg	Tyrosine* in urine mg	Age days	Vitamin C supplement mg	Tyrosine* in urine mg
	A. B.			G. A.	
38		953	20		448
39	200	940	21		477
40	200	67	22	50	524
41	100	33	23		401
42	25	37	24		436
			25	100	176
	A. C.		26		36
45		1,079			
46		1,067		G. B.	
47	200	324	18		606
48	200	38	19		654
49	100	32	20		534
			21	100	322
	J. P.		22		48
11		525	23		39
12		627	28		281
13	75	619	29		469
14	75	251	30		619
15		30	31	200	494
16		24	32		340
			33	200	170
			34		40

* Million reaction.[5] Figures represent hydroxyphenyl compounds expressed as tyrosine.

Analysis of the blood in three of the infants in the control periods showed no ascorbic acid.[8] After administration of vitamin C in amounts sufficient to suppress the excretion of hydroxyphenyl compounds, the blood ascorbic acid was still low, varying from 0.13 to 0.32 mg per ml, indicating that although a change in cellular oxidations had taken place, the blood had not reached normal levels. Roentgenograms of the long bones revealed no signs of manifest scurvy. The evidence suggests that the metabolic aberration in premature infants is an interrelated function of the level of intake of the aromatic amino acids, phenylalanine

[1] Assistance in this work was given by the Children's Bureau, U. S. Department of Labor.

[2] S. Z. Levine, *Am. Jour. Dis. Child.*, 58: 674, 1939.

[3] G. Medes, *Biochem. Jour.*, 26: 917, 1932.

[4] K. Closs and A. Fölling, *Ztschr. f. physiol. Chem.*, 254: 258, 1938.

[5] O. Folin and V. Ciocalteu, *Jour. Biol. Chem.*, 73: 627, 1927.

[6] R. R. Sealock and H. E. Silberstein, SCIENCE, 90: 517, 1939.

[7] E. Alderhalden, *Fermentforschung*, 15: 522, 1938.

[8] R. L. Mindlin and A. M. Butler, *Jour. Biol. Chem.*, 122: 673, 1938.

and tyrosine, and the degree of saturation of the tissues with vitamin C. Whether the same metabolic error is present in full-term infants under similar dietary conditions or in older infants with manifest scurvy is at present being investigated. Studies are also under way to determine the specificity of vitamin C in remedying the defect. The spontaneous occurrence of hydroxyphenyl compounds in the urine of premature infants fed cow's milk deficient in vitamin C affords the opportunity of studying the intermediary metabolism of aromatic amino acids in the growing human organism.

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REACTION OF VARIOLA VACCINE VIRUS TO ROENTGEN RAYS[1]

ROENTGEN ray irradiation of variola vaccine virus particles causes a reduction in number of active particles. The rate of inactivation proceeds exponentially.

Vaccinia virus[2] for irradiation was extracted from infected rabbit testis preserved in glycerine, by grinding the testis in sand and diluting it 1:10 with Locke's solution. After centrifuging, 0.75 cc of the supernatant solution which carried the virus was exposed to x-rays from a copper target tube.[3] The mean effective wave-length of this radiation was found to be 1.5 Å. The reduction in the velocity of virus inactivation was determined by titration experiments in which 0.1 cc of the irradiated and the control virus suspensions were inoculated intradermally into normal rabbits. Estimates of the infectious particles, remaining after irradiation, were made from those tests in the dilution series which gave both positive and negative takes.[4]

The inactivation curves of three experiments, in which vaccinia virus was irradiated with increasing dosages of x-rays, are plotted in Fig. 1. The logarithms of the numbers of infectious particles are the ordinates of the graph. The abscissae represent the Roentgen units of irradiation incident to the surface of the virus solution. Each curve is evidently linear

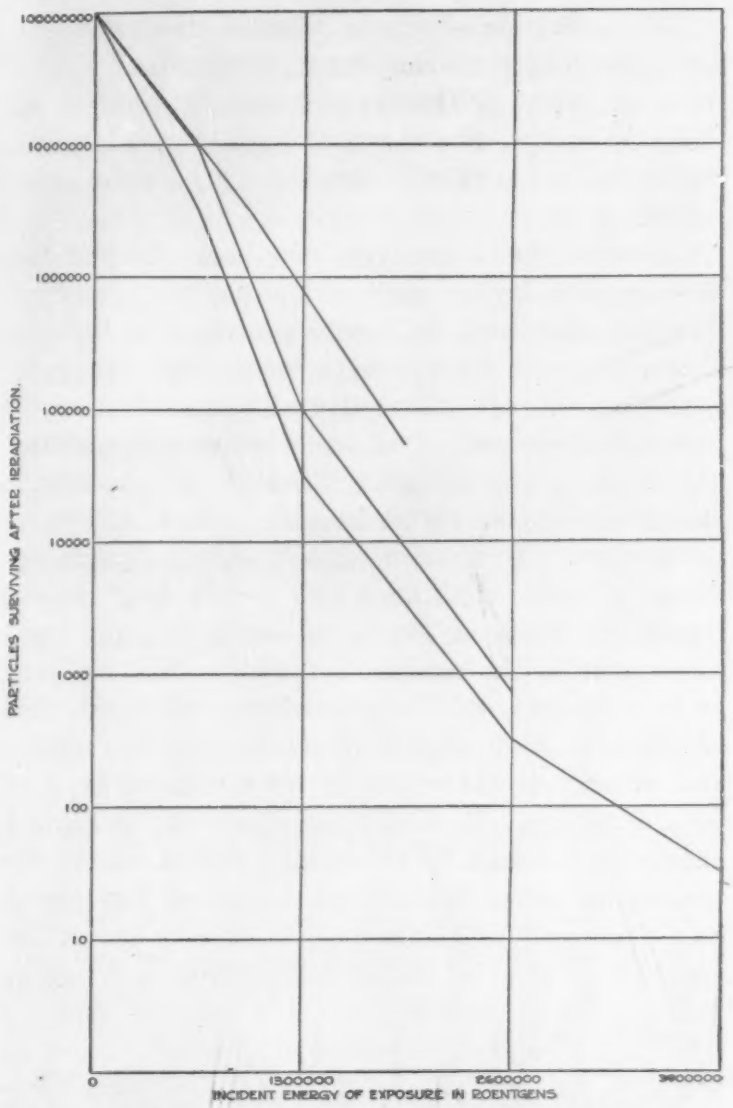

FIG. 1. Survival ratios of vaccinia virus treated with Roentgen rays of 1.5 Å.

in its trend; the inactivation of virus particles begins when irradiation commences. The small quantitative differences in the slope constants which do occur are partly accounted for by small variations in the Roentgen units in each experiment.

The linear nature of the raw data when plotted on the semi-logarithmic coordinates, and the absence of any initial lag during the inactivation of the virus is expected if we assume that one unit of radiant energy is sufficient to inactivate an infectious unit of the virus. The curve form would further postulate that the ultimate virus particles are held separate and distinct from each other in the water suspension when irradiation takes place—not in any conglomerate of particles—for if they were conglomerate the entities would require more than one unit of x-ray energy for inactivation and consequently lead to raw data having an initial lag period and a convex curvature instead of the straight lines observed.

The experimental observations are due to the inability of certain virus particles to reproduce after they have absorbed a unit of irradiation. The portion of the virus particle with which we are dealing is therefore only that which has to do with reproduction.

[1] Journal paper No. J-676 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 573. We are indebted to the Fuller Fund and the International Cancer Research Foundation for assistance in these researches.

[2] We are pleased to acknowledge our indebtedness to Dr. A. B. Sabin for the dried virus from which these experiments were started.

[3] L. E. Pinney, *Iowa State College Jour. Sci.*, 13: 269–273, 1939. We are indebted to Mr. Pinney for much other assistance.

[4] K. Iwaszkiewicz and J. Neyman, *Acta Biol. Exp.*, 6: 101–142, 1931.

The inactivation effects on vaccinia are similar to those observed for a widely separated group of viruses affecting plants. When exposed to radiant energy of either the x-ray[5] or ultra-violet[6] these viruses are also inactivated, the survival ratios following simple exponential curves of constant slope.

Curves of the linear type have been observed for several more highly organized forms of life when they are inactivated by Roentgen rays. The bacteria *Escherichia coli, Salmonella aertrycke* and *Staphylococcus aureus*[7] are all inactivated in this manner by various wave-lengths. *Drosophila melanogaster* sperm[8] are killed in like manner. These Drosophila results are of particular interest because of their analytical possibilities. Irradiation of Drosophila sperm by x-rays of wave-length from 2.29 Å–0.01 Å of radium caused (1) death in certain of the sperm, (2) rearrangements in the chromatin (either within the gene or linin thread) which expressed themselves as lethal effects in succeeding generations, crossing-over effects and phenotypic differences of the non-lethal type of gene mutations. Each of these effects of the radiant energy is described by exponential curves. Since the gene which makes these changes seems best interpreted as a single unit, and since the gene in some cases after radiation is modified rather than destroyed, it follows that the energy absorbed within it must be absorbed by different parts of the molecular structure, each dealing with different phases of the gene's several functions. Diverse expression of radiation effects are thus to be expected on irradiating viruses and may be expressed by loss of reproductive capacity (inactivation) and by mutation. Mutation effects and methods of converting the Roentgen dosages incident to the surface of the virus solution to those actually received by the virus will be discussed in the completed work.

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ELECTROPHORETIC STUDY OF PITUITARY LACTOGENIC HORMONE[1]

AN electrophoretic study of White's crystalline lactogenic hormone has been reported by Shipley *et al.*[2] Using the Hellige apparatus developed by Tiselius,[3]

[5] John W. Gowen and W. C. Price, SCIENCE, 84: 536–537, 1936.

[6] W. D. Price and John W. Gowen, *Phytopath.*, 27: 267–282, 1937.

[7] R. W. G. Wyckoff, *Jour. Exp. Med.*, 52: 769–780, 1930; R. W. G. Wyckoff and T. M. Rivers, 51: 921–932, 1930; R. W. G. Wyckoff, 52: 435–446, 1930.

[8] J. W. Gowen and E. H. Gay, *Genetics*, 18: 1–31, 1933.

[1] Aided by grants from the National Research Council, the Rockefeller Foundation and the Board of Research of the University of California.

[2] R. A. Shipley, K. G. Stern and A. White, *Jour. Exp. Med.*, 69: 785, 1939.

[3] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

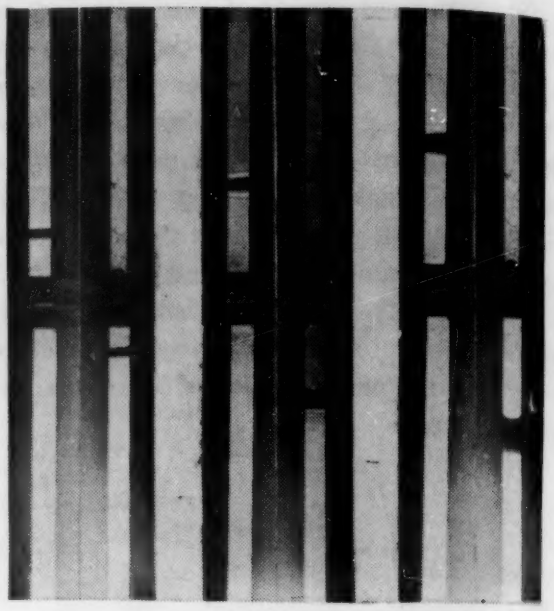

FIG. 1.

we have investigated the electrophoretic behavior and iso-electric point of our own lactogenic preparations.

The lactogenic hormone (L 269) was prepared in

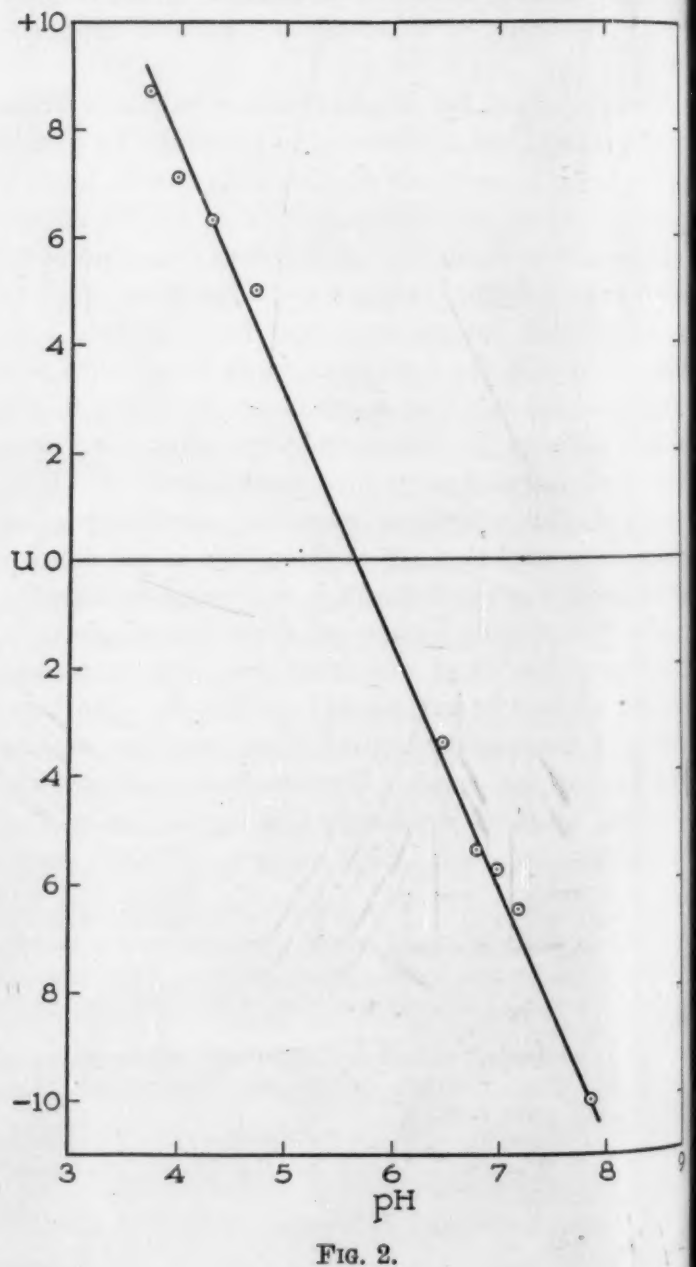

FIG. 2.

sentially the same manner as previously published[4,5] d contained approximately 20 Riddle-Bates units per g. L 269 also caused lactation in normal, virgin, ost-oestrus guinea pigs in a total dose of 4 mg or s. The hormone was dissolved with the help of a all amount of acid or alkali and dialyzed against the sired buffers for 24 hours or more until there was difference in the pH and conductance between the alysate and the buffer. The ionic strength of the osphate or acetate buffer solutions was 0.055 in all periments. The potential gradients were kept prac-ally constant (*ca.* 9 volts/cm).

The schlieren photographs, taken at 15-minute inter-ls in a typical experiment with a 0.5 per cent. solu-n, are shown in Fig. 1. They show only one sharp undary throughout the experiment. Since Tiselius[6] s demonstrated that 0.02 per cent. protein solution n be detected by electrophoresis, the single boundary own by L 269 indicates that in all probability no eat amount of contaminant, if any, is present.

The results of mobility studies made with 0.2–0.3 per cent. solutions of L 269 are recorded in Fig. 2. The + and − refer to charge on the protein, which is presumably the hormone. It will be seen that the iso-electric point of the preparation falls at pH 5.70. It is interesting to note that Shipley *et al.*[2] have reported an iso-electric point of approximately pH 5.6 for their preparation, although of the 4 electrophoresis experiments made with their crystalline prolactin, only 2 were made with "native" substance.

While it may be concluded that the single sharp boundary observed in these electrophoretic studies of our lactogenic preparation is suggestive of its purity, a more decisive conclusion may be reached from solubility studies now in progress.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE DETERMINATION OF CAROTENE

In the study of plant pigments two methods were veloped for the quantitative determination of caro-ne. Willstätter[1] used a two-phase solvent extrac-on method for separating carotene from xanthophyll d chlorophyll. Tswett[2] made use of an adsorbing lumn through which he passed a solution of plant gments forming a chromatograph of the plant pig-nts with complete separation of carotene.

Many modifications of these two methods have been veloped since Moore[3] discovered that carotene was nverted into vitamin A. Schertz[4] modified Will-tter's method so that carotene, xanthophyll and lorophyll could be determined quantitatively. Guil-rt[5] modified Schertz method so that carotene deter-inations could be made more rapidly. Peterson, ughes and Freeman[6] modified Guilbert's method by iminating several unnecessary steps which further duced the time required for making carotene deter-inations. Strain[7] used a modification of Tswett's ethod for obtaining carotene in crystalline form.

In the routine analysis of a large number of mples of dehydrated alfalfa for the quantitative determination of carotene any modification of the Willstätter method required considerable mechanical manipulation. Tswett's method, although requiring a longer time for the extraction of the plant pigments, is quite simple, rapid and accurate. For the past several years we have been using a modification of Tswett's method for the determination of carotene in dehydrated alfalfa.

Briefly, this method consists of placing a one-gram sample of alfalfa in a flask, to which is added 100 cc of petroleum ether. The flask is stoppered and set aside over night. The petroleum ether solution of plant pigments is poured on a column of finely divided soda ash and drawn through the column by the aid of suction. A chromatograph of the various plant pigments forms on the column with the separation of carotene, which passes through with the petroleum ether. Some of the petroleum ether is absorbed by the soda ash so that it is necessary to add fresh petroleum ether until it comes through clear in order to elute all the carotene from the column. The filtering column is made of a filter tube with a small plug of cotton in the bottom upon which is packed soda ash. Tswett recommended the use of MgO or $CaCO_3$. We find, however, that soda ash is to be preferred to any other adsorbent which we have used.

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[6] A. Tiselius, *Biochem. Jour.*, 31: 1464, 1937.
[1] "Carotinoids and Related Pigments," L. S. Palmer, p. 202. The Chemical Catalog Co., Inc., 1922.
[2] *Ibid.*, pp. 203.
[3] Thomas Moore, *Biochem. Jour.*, 241: 692, 1930.
[4] F. M. Schertz, *Plant Physiology*, 3: 211, 1928.
[5] H. R. Guilbert, *Ind. Eng. Chem.*, Anal. Ed. 6: 452, 34.
[6] W. J. Peterson, J. S. Hughes and H. F. Freeman, *Ind. Eng. Chem.*, Anal. Ed. 9: 71, 1937.
[7] H. H. Strain, *Jour. Biol. Chem.*, 3: 85, 1935.

PROTECTION OF HERBARIUM SPECIMENS

THE use of Cellophane or any similar substance as a protective covering for herbarium sheets may not be an entirely new idea; the extent to which it is employed, however, may be readily determined by a visit to any one of the large Herbaria of this country. It would appear that some such method of covering would find greater application if a simple way of sealing the cover to the herbarium sheet were available. In schools and colleges where herbarium specimens are much used for teaching purposes it is often found that the friable nature of dried specimens is very much of a drawback to their full employment. It is possible that no satisfactory method of fixing a transparent cover over herbarium sheets has so far been introduced, so that the following particulars may prove of service to those concerned with the use or care of such specimens.

The actual covering material used by the writer has the trade name of "Flexiglass." It is a non-inflammable Cellophane-like synthetic substance, perfectly transparent and tough. It is obtainable in various thicknesses from most of the firms dealing with the usual laboratory supplies. From 1/20 mm to 1/10 mm is the range most suitable for the present purpose. If a standard size of mounting-sheet is used the Flexiglass may be purchased ready cut to the required dimensions or it may be bought in rolls for cutting to any odd sizes.

The firm of Offrex Ltd., 15 Newman Street, London, W.1., has placed on the market a very simple type of instrument called the Offrex Edge Binding Machine. This is easily operated and provides an excellent means of fixing the Flexiglass to the ordinary herbarium sheet. Particulars for operating the machine, a very simple process, are supplied with it.

A piece of the Flexiglass is cut to the size of the herbarium sheet in use and the dry specimen covered with this. The edges of the sheet and the cover, in register, are run through the machine and the edges thus bound together with tape. A range of colored tapes is available. An intelligent boy can bind up a sheet in about two minutes if supplied with ready-cut Flexiglass.

The initial cost of the machine with a supply of tape and Flexiglass amounts to about £4. The machine itself will, of course, serve many useful purposes, such as rebinding worn separates, strengthening wall diagrams, etc., and will last for years. The Flexiglass covering will be found to improve considerably the appearance of the specimens as well as protecting them from injury in handling or storage. The thicker material may be used for any valuable or delicate specimens that need to be stiffened as well as covered.

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MARKING ROCKS, MINERALS AND FOSSI

CELLULOID dissolves in acetone in almost any p portion. Both substances are cheap and abunda The celluloid, preferably clear, colorless, but discard from other uses if need be, is chipped with scissors a dropped piece by piece into a wide-mouthed grou glass-stoppered bottle until the solution attains the d sired consistency (about that of thin mucilage). M of either can be added if, after trial, the consisten is not quite as desired.

Numbers or name labels are prepared by printi with india ink on good linen paper. Paper can trimmed from waste letter heads of wealthy firms f economy's sake. When labels are made and ink is d use a small camel's-hair brush or even a toothpick lay upon the specimen a small patch of the soluti larger than the label. Before it dries press the la into the solution. As the acetone evaporates a ce loid film is left between the specimen and the pap When the first application is about dry, spread a la of the solution over the label and bordering soluti and let all dry completely. There is then a "capsu of celluloid firmly attached to the specimen with t label inside. It can be washed and handled with i punity. A series of specimens may be given the f step and allowed to dry before starting the seco step.

Some of the more porous rocks as clays and inf sorial earth sometimes release the celluloid unless little shellac or varnish is first applied and dried.

This labeling material finds other uses in geolo laboratories. It has been used to make impressi of fossils and sections of surfaces by spreading it o a surface and, when dry, stripping it off, thus maki a delicate, exact film of the fossil surface.

GEORGE D. HUBBARD

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BOOKS RECEIVED

ARTHUR, PAUL. *Lecture Demonstrations in General Che istry.* Pp. xvi + 455. 113 figures. McGraw-Hill. $4.
Aspects of the Calculus of Variations. Notes by J. GREEN after Lectures by HANS LEWY. Pp. vi+ University of California Press, Berkeley. $0.75.
BENNETT, HUGH H. *Soil Conservation.* Pp. xvii+ 358 figures. McGraw-Hill. $6.00.
BORGSTRÖM, GEORG. *The Transverse Reactions of Pla* Pp. 230. 58 figures. Ejnar Munksgaard, Copenhag 6 kr.
Cambridge Philosophical Society, Proceedings. Volu 35, Part 4. Pp. 527–663. Cambridge University Pre 10/6.
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SCIENCE NEWS

Science Service, Washington, D. C.

THE SYMPOSIUM ON COSMIC RAYS

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COSMIC RAYS originate within the galaxy of stars which contains the sun and the earth, according to the report of Professor Arthur H. Compton, of the University of Chicago, at the symposium on cosmic rays at the University of Chicago.

Calculations show, Professor Compton indicated, that if the cosmic rays come from beyond the galaxy the northern hemisphere of the earth (the forward moving face of the earth) ought to receive one half per cent. more cosmic rays than does the southern hemisphere.

For three years Professor Compton's sensitive instruments for detecting cosmic rays have been aboard the *S.S. Aorangi* traveling back and forth between Vancouver, B. C., and Tasmania. The cosmic ray intensity received aboard the ship shows no such variation of one half per cent. The probable error of the readings is appreciably less than one half per cent. Professor Compton concludes that the evidence so far is most consistent with the view that cosmic rays rotate with our galaxy and do not come from outside.

Hesotrons—the newest kind of atomic particle found in cosmic rays and having a mass some 100 to 200 times as great as an electron—appear to be created by the bombardment of the upper atmosphere of the earth by the charged cores of hydrogen atoms (protons) coming in from outer space, according to Dr. Thomas H. Johnson, of the Bartol Research Foundation of the Franklin Institute. He explained that most of the mesotrons (extremely piercing component of cosmic rays on earth) appear to come from the westerly direction just as do positively charged particles found in the cosmic rays. He therefore concludes that impact of protons on the air in the stratosphere creates most of the mesotrons.

Dr. Victor F. Hess, who won the Nobel Prize in 1936 for first discovering cosmic rays twenty-four years earlier, described a small, almost undetectable 27-day cycle of cosmic-ray intensity which he explains as due to the magnetic field of the sun. The period of rotation of the sun is also 27 days.

THE MESOTRON

(Copyright, 1939, by Science Service)

WHILE a hundred distinguished physicists gathered at the cosmic ray symposium at the University of Chicago, the meeting has been—in many ways—an honor for a Japanese 6,500 miles away.

Through the score and more of profound, prepared addresses, summarizing the known knowledge about cosmic rays, one word has appeared again and again. That word is mesotron and that is where Professor Hideki Yukawa, of Osaka University, comes in.

It was he who first suggested, in 1935, a kind of then-undiscovered particle which has since come to be called the mesotron. Two years later the mesotron was discovered by Drs. Carl Anderson and Seth Neddermeyer, of the California Institute of Technology, and almost simultaneously by Drs. J. C. Street and E. C. Stevenson, of Harvard University.

Professor Yukawa is not an expert in experimental cosmic ray investigations. He is a theoretical physicist with a fertile mind who had an excellent idea. What he started out to do, when he suggested mesotron particles—then unnamed—was to create a better explanation of the nuclear forces which bind atoms together. He conceived a kind of particle that would have the electrical charge of an electron, a mass about 100 to 200 times as great and—most important—the ability to disintegrate spontaneously. In the interchange of energy between two elemental particles the mesotron was conceived to help in the transfer and then die spontaneously by disintegration.

At this time the "Yukawa particle" passed unnoticed among most physicists. It came into prominence only when "heavy electrons" were found as a new and important constituent of cosmic radiation. Then it turned out that the "Yukons"—as they were sometimes called after Yukawa—were virtually a blue print supplied in advance to interpret the new discovery. For a year the terms Yukons, heavy electrons, X particles, and barytrons battled for acceptance in the scientific literature until finally Dr. Anderson suggested the present name mesotrons that has found general acceptance.

Mesotrons appear to give a reasonable explanation for the extremely piercing component of cosmic rays which are detected deep down in mines. They appear to be generated within the earth's own atmosphere by the impact of cosmic rays coming at the earth from outer space.

ECONOMIC CONDITIONS IN THE STONE AGE

THERE is nothing new in our economic roller coaster with its ups and downs taken at top speed. Europeans in the Stone Age had to get used to quick economic changes and made the revolutionary change from a hunting life to agriculture abruptly, according to a paper read by Professor V. Gordon Childe, the archeologist of the University of Edinburgh, at the meeting of the Pacific Division of the American Association for the Advancement of Science.

The economics of the New Stone Age in northern Europe, over 4,000 years ago, are being emphasized in archeological studies. In the oldest Swiss lake dwellings of the New Stone Age, the people lived on meat of domestic animals mainly. Only thirty per cent. of their meat bones, left for archeologists to explain, are bones of wild game animals. But later on, nearly half the meat eaten by the lake dwellers was game, showing a back step in economic progress. The earliest pottery at these lake dwellings is pronounced "a magnificent product" by Professor Childe, while later people turned out coarse stuff.

Abruptness with which the New Stone Age developed in northern Europe, calling for a break with the hoary tradition of Old Stone Age hunting life, is seen by Professor Childe as evidence that the idea of farming economy was a foreign importation. This mode of life was worked out, he says, in the Fertile Crescent of the Near East, where

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(1) McIlwain et al, *Biochem. J.*, 33:223 (1939) "Glutamine and the Growth of Streptococcus Haemolyticus."

(2) M. Landy, General Biochemicals, Inc. (To be published)

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American excavators are now probing the origins of settled existence, beneath cities over 5,000 years old.

Professor Childe is convinced that trade and specialization of industry in Europe began no later than the dawn of the New Stone Age.

"Flint was systematically mined in Belgium and southern England," he said, "and the miners must have lived by bartering their products with neighboring groups. Axes were made from a specially suitable rock at Penmaenmawr in North Wales and exported as far as Wiltshire and Astrim. But the commodities thus traded were in fact luxuries; the consuming communities could have got along without them."

The village of Skara Brae in Orkney, Scotland, which Professor Childe unearthed, reveals to a modern world that New Stone Age people could be self-sufficing, but also the penalties of isolation. These remote villagers lacked timber, but they made their furniture, even to beds and dressers, out of stone, and built relatively large huts. They neither raised crops nor hunted or fished regularly, but lived mainly by breeding cattle and sheep. No trace of imported articles has been found in this exhibit village of a prehistoric adjustment to economic problems.

VITAMIN CONTENT OF BREAD

A LOAF of white bread which has the vitamin B_1 content of a whole wheat loaf, some five times as much as ordinary white bread, was predicted to the food conference at the Massachusetts Institute of Technology by Charles Frey, Alfred Schultz and Lawrence Atkin, all of the Fleischmann Laboratories.

Vitamin B_1, or thiamin, is an important factor in nutrition, but it is not stored in the body to any significant extent and thus must be contained in basic foods. Cereal products, mainstay of the national diet, are suitable for this, but these products, especially bread, have been increasingly deprived of their natural vitamin content in recent years.

The problem of restoring this loss, sometimes as great as ninety-three per cent., has been tried along many lines, but the latest and most practical employs a new yeast. This yeast contains enough thiamin to produce a loaf of white bread with the vitamin content of a whole wheat loaf, but without any loss of palatableness. Although made by a new process, the yeast offers no new technical problems since its baking properties have not been altered. Possibility of such a loaf at a low cost increase would be a boon to low income groups.

Research aimed at irradiating yeast to convert its natural ergosterol to vitamin D and to include milk solids to supplement cereal protein and minerals in the "staff of life" were also described.

RADIO SCIENTISTS FIND HOLES IN TROPICAL STATIC

(*Copyright, 1939, by Science Service*)

RADIO listeners plagued with the roar of summer static may find some encouragement in the results reported by Dr. G. W. Kenrick and Peter J. Sammon, of the University of Puerto Rico, to the meeting, in San Francisco, of the Institute of Radio Engineers.

Observations conducted in the tropics during the past few years have used radio direction finders of special design to locate static's origin much in the same way that we may trace the course of ships. Most of the static received in the United States in winter is found to come from Central and South America, while the instruments used are sensitive enough to detect some coming from Africa and other far-off continents.

Static fades just as the signals received on the same wave-lengths fade. Under some conditions these effects cause sudden drops in the static intensity usually at periods near sunrise and sunset. At the University of Puerto Rico, automatic recorders measure this static intensity day and night, and Dr. Kenrick showed examples indicating a sudden drop in static intensity persisting for minutes or even hours. Examples were also shown of use of static to study the path of hurricanes which may sometimes be traced by associated atmospherics. It was pointed out, however, that this static was usually feeble compared to that originating in thunderstorms in the tropical Americas and, during summer, in the United States.

Dr. Kenrick also showed results obtained in his studies of radio signal intensities and the upper atmospheric layers responsible for long distance radio. In the tropics these layers behave differently than in the North, but despite the small changes in temperature found in Puerto Rico, signal changes due to this radio roof seem even greater than in the rigorous climate of the northern United States.

ITEMS

THE average person grows up a trifle lopsided, with a right arm bigger than his left. Comparatively few children or adults with equal-sized right and left arms were found, when Professor Clarence R. Van Dusen, of the Michigan State College, measured arms of nearly 100 small children and 77 grown-up college men. While the right is most likely to be longer, sometimes bigger left arms were found. So far as full length of arm goes, children are more apt to have longer right arms than adults, Professor Van Dusen says in a report to *Human Biology*. In adults the more frequent occurrence is a bigger right forearm, that is, longer, wider with the palm broader. The use that a right arm gets in every-day living may play some part in one-sided development. But Professor Van Dusen considers it probable that a tendency toward a mightier right may be a normal growth process attributable to heredity.

JAWBONE and shoulderblade of a small mammal that lived during the Age of Dinosaurs have recently been found in a coal mine in South Manchuria, and are described by H. Yabe and T. Shikama in a report to the Imperial Academy at Tokyo. The creature must have been quite small, no larger than a squirrel, for the jawbone is only a little more than an inch long. The teeth are primitive and simple in structure, from which circumstance the animal has been named *Manchurodon simplicidens*. The stratum in which the fossils were found belongs to the Jurassic geologic period, with an age estimated at between 120 and 150 million years.

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SCIENCE NEWS

Science Service, Washington, D. C.

SUPER-HEAVY ELEMENTS AND COSMIC RAYS

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THE astounding picture of cosmic rays generating in the dense white dwarf stars of the universe by the splitting of super-heavyweight elements, nearly 10,000 times as massive as any known on earth, is suggested by Dr. Felix Cernuschi, Argentine exchange scholar at the Massachusetts Institute of Technology.

To generate cosmic ray particles of 1,000,000,000,000 electron-volts, like those which have been observed, requires elements having atomic number 10,000 and atomic weight 26,000. (The heaviest element found on the earth is uranium of atomic number 92 and atomic weight 238.)

In a report to *The Physical Review*, Dr. Cernuschi suggests that the kind of splitting recently found to occur in uranium under neutron bombardment—which makes a single uranium atom liberate about 200,000,000 electron-volts of energy—is possibly going on in his hypothetical super-heavy elements too.

His X elements, or whatever name they may be given, would break down into two fission elements having atomic number 5,000 each. And then these would each in turn go into an element of 2,500 atomic number and so on; all the while liberating tremendous quantities of atomic energy that would appear both as light and as invisible atomic particles (the cosmic rays).

The new Cernuschi hypothesis is not only intriguing because it is the first application of the new uranium splitting phenomenon to cosmic ray theory, but also because the suggestion of super-heavyweight elements would account for the known dense white dwarf stars. These stars, like the small dwarf companion of the bright star Sirius, are known to have a density 50,000 times as great as water. A cubic inch of the material from this star would weigh tons. It has previously been suggested that such stars were "collapsed" stars consisting only of neutron particles. Dr. Cernuschi's suggestion gives an alternative explanation which possesses the additional virtue of providing a reasonable explanation of the origin of cosmic rays.

Professor M. S. Vallarta, well known for his work in astrophysics and cosmic rays, was the faculty adviser of Dr. Cernuschi.

Drs. W. Baade and Fritz Zwicky, of the California Institute of Technology, have suggested that super-novae stars (having a brightness of more than 630,000,000 times that of our sun) were exploding stars and the place of origin of super-high energy particles like those found in cosmic rays. Dr. Cernuschi says he is unable to agree with parts of their reasoning as to this origin of cosmic rays and adds that no known atomic transmutations appear sufficient to account for the tremendous energies cosmic rays possess. Hence he calls on his new hypothesis of the fission of super-heavyweight elements.

THE NEW 60-INCH CYCLOTRON

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THE world's most powerful beam of atomic "bullets" for bombarding atoms has been generated in the new 60-inch cyclotron of the University of California.

In its first official test the new instrument, whose magnets alone weigh 250 tons, generated deuterons of 16,000,000 electron-volts energy. When the nuclei of helium are used for the "bullets" it will be possible to produce a beam of alpha particles having an energy of 38,000,000 electron-volts.

In a report to *The Physical Review*, a research team of eight investigators, headed by Professor Ernest O. Lawrence, describes its success in the first test of the newest and most powerful atom-smasher in any physical laboratory. Nor is the present energy the limit, they say. "We . . . see no difficulties in the way of producing with the present equipment 25 million volt deuterons and 50 million volt alpha-particles, and moreover we are convinced that much higher energies could be obtained from a cyclotron of larger dimensions." Professor Lawrence has already suggested that a 1,000-ton cyclotron could be constructed to go to even larger energies. The present test substantiates in real performance his previous hopes.

So potent is the beam from the new cyclotron that its particles can be observed emerging in air from the target window for a distance of over a meter and a half, or about five feet.

CHEMICAL USED IN PHOTOSYNTHESIS

DISCOVERY of a chemical that allows the green plant to inhale waste carbon dioxide from air is announced by the Smithsonian Institution.

This hitherto unsuspected substance is a go-between for carbon dioxide and chlorophyll, the green coloring matter of plants. It seizes a molecule of carbon dioxide and delivers it to the chlorophyll. It is therefore one of the most important substances on earth, as without it sunshine energy could not be trapped in vegetation.

Dr. E. D. McAlister, biophysicist of the Smithsonian Institution, made the observation while making extremely delicate measurements of the amounts of carbon dioxide used by wheat seedlings. He found that plants continued to use carbon dioxide for a short interval after they had been plunged into darkness, which was contrary to conventional ideas about photosynthesis. He concluded that some intermediate chemical was playing an essential rôle.

The existence of the new chemical basic to life was thus demonstrated, but so fleeting is its existence that Dr. McAlister does not believe that it will ever be possible to isolate any of it.

Chlorophyll, by the process called photosynthesis, enables the plant to use sun energy to manufacture out of water from the soil and carbon dioxide from the air the various hydrocarbons, such as cellulose, starch, etc., used by men and animals for food and other purposes. Coal and oil contain the sunshine of past ages trapped in this way. Our breathing and the burning of fire use oxygen and pour out carbon dioxide into the air, while photosynthesis manufactures oxygen for the air. Thus the new chemical believed essential to photosynthesis is one of the important links in the energy cycle of life on earth.

NEW FILM FROM CLAY

THE United States may soon be able to replace most of its imports of valuable sheet mica with an American-made substitute, it appears from chemical discoveries reported to the colloid symposium at the Stanford University meeting of the American Chemical Society.

The new mica substitute is Alsifilm, made from bentonite clays. Its development has been under way for some time and was first reported last year. The new advances and improvements were described in a paper presented by Professor E. A. Hauser, of the Massachusetts Institute of Technology, and Miss D. S. le Beau, of the Dewey and Almy Company, Cambridge, Mass.

The new film can be made thin and almost transparent (looking like celluloid or Cellophane) and has superior electrical insulation properties. It is composed of inorganic materials that make it fireproof. Mica sheet is at present on the War Department's list of strategic materials of which the United States lacks adequate sources.

The bentonite clays are remarkable materials most commonly known for their ability when wet to swell to many times their dry size. One common use of bentonite is for sealing leaks in earth dams or in ditches. Wet bentonite closes the cracks. As it dries it shrinks, a little water penetrates, then it becomes wet and swells up again. This process is repeated indefinitely.

In the form of thin films bentonite is compressed strongly into a permanently stable material which is virtually impervious to water and does not swell as does bentonite normally.

As a substitute for sheet mica the new film may be expected to replace, to some degree, existing imports of this strategic material. In 1938 sheet mica imports amounted to 4,646 tons of unsplit mica and 1,115 tons of split mica. The value of imports of sheet mica in 1938 was $664,419.

VACCINE AGAINST HORSE PLAGUE

(Copyright, 1939, by Science Service)

TRAGEDIES such as the death from horse "sleeping sickness" of Dr. Charles E. Salsbery, of Kansas City, Mo., veterinary biologist who acquired the illness in the course of his scientific work, will probably be prevented in future.

A vaccine against the disease will be the means of preventing these tragedies. Such a vaccine already has been used successfully in protecting horses and a modified vaccine has been developed for human use. From 50 to 100 men and women who handle the dangerous virus in disease-fighting laboratories have already been vaccinated, according to information received by the U. S. Public Health Service.

The Federal Health Service, when asked, has advised firms manufacturing the horse-protective vaccine that they would be justified in using the horse vaccine to protect their employees so long as nothing better was available. Within the last month (June 9) the development of a vaccine suitable for human use was reported by Dr. Ralph W. G. Wyckoff, of the Lederle Laboratories at Pearl River, N. Y.

Dr. Salsbery was the fourth to be stricken with the disease in the course of the work. One other of the four, a girl laboratory technician, also died of it, the U. S. Public Health Service has learned. The name of the girl martyr and the laboratory where she was employed is withheld as being "confidential information."

Scientists and laymen alike were shocked at the announcement last fall of the first proved human cases of this horse ailment, which has the technical name of equine encephalomyelitis. There are two different viruses, one the Eastern and one the Western type. The Eastern type is more fatal among horses and according to present knowledge is apparently more fatal among humans also.

Thirty-eight human cases of the horse plague were reported in Massachusetts last year, of which 20 were fatal. There were six cases with one death reported from Minnesota and one fatal case in a child reported from California.

How the disease spreads is still a mystery. According to one theory, the virus is spread by mosquitoes or other insects, and some investigators believe that birds, rather than horses, constitute a reservoir of the disease. None of these theories has been proved as yet.—JANE STAFFORD.

THE TEMPERATURE DURING JULY AND AUGUST

(Copyright, 1939, by Science Service)

JULY and August are going to be warmer than average, if this summer's weather follows the pattern determined by many years of observation, according to Charles D. Reed, senior meteorologist of the U. S. Weather Bureau. Mr. Reed bases his long-range forecast on the high-temperature record established for May and June.

May was an especially warm month over the country's great crop areas generally, with a "plus departure" of about six degrees for the month in Iowa. June has shown about two degrees in excess of normal. Statistical studies have shown that when May and June temperatures together are that much above normal they are practically invariably followed by a hot summer. Mr. Reed's figures and forecasts are based primarily on Iowa conditions, and apply with decreasing pertinence over widening zones away from that midland center.

Based on the general temperature forecast is a second forecast by Mr. Reed, that not more than five per cent. of Iowa's great corn crop will be caught by frost next fall. Over a fifteen-year period, the average amount of frosted corn comes to 15 per cent. of the total crop, so that the expected 95 per cent. of frost-free corn for this year will represent a considerable gain.

The most uncertain quantity involved in this crop forecast is the question whether the excess temperatures to come during the next two months will be high enough to harm the corn. A let-up in the rains is normally to be expected after the end of June, but shortage of moisture alone is less damaging to corn than too high temperatures even when there is a moderate amount of moisture remaining in the soil.

Fears aroused by a dry May that the summer of 1939 would be another disastrous drought season have been well dissipated by a June that brought abundant rainfall. By contrast with its arid predecessor, June has seemed an excessively wet month, but official figures show only a slight to moderate excess in precipitation for the month. However, soil moisture is mostly in normal condition, so

that crops are in relatively good situation for the long pull through the hot-weather weeks ahead.—FRANK THONE.

THE PSYCHOLOGY OF CROWDING AND AIR TRANSPORT

(*Copyright, 1939, by Science Service*)

THE bad psychological effects of overcrowding of passengers will place a limitation on the size of long-range transport airplanes, it was reported at the San Francisco meeting of the American Society of Mechanical Engineers. A. F. Bonnalie, assistant to the director of flight operations for United Air Lines Transport Corporation, said, "One thing that seems to have definite limits, at least for any long-range aircraft, is the rapidly increasing crowding effect with increased numbers of passengers. . . . The problem becomes most acute when any more than a relatively small number of passengers are involved for more than a relatively short space of time."

The most crowded condition is represented by a trip of six people in a small motor car. About 114 cubic feet of space is available, or about 19 cubic feet per person. This is tolerable only for a group of friends or relatives with common interests and then only because the scenery is changing very rapidly near-by the car. High overhead in an airplane the scenery frequently is monotonous except on those particular flights which may traverse a mountainous region. Over-ocean flying is notoriously monotonous after the first few hours.

It is probable, according to experts, that 19 cubic feet of space for each passenger is the lower limit at which passengers can be attracted to aerial transport. Mr. Bonnalie pointed out that "As the number of passengers increases the difficulty of providing for the human pay load increases faster than the numbers involved. Even the development of airplanes large enough to have habitable wings may not be more than a minor relief. It is also going to be necessary to take these factors into consideration in the construction of terminal facilities, waiting rooms, and so on."

ITEMS

THE flash flood at Morehead, Ky., which brought death and heavy property damage to that little mountain community was caused by heavy rains of more than 2.6 inches in 48 hours, according to the report of the flood division of the U. S. Weather Bureau. The only rainfall station near Morehead is at Pikesville, Ky., where 0.58 inch of rain fell for the 24 hours ending July 4 at 7 A.M. For the next 24 hours rainfall was 2.02 inches, an almost unprecedented amount for this region. Louisville, Ky., and Cincinnati, Ohio, reported no precipitation and there is no flood danger on the major rivers and tributaries.

A HUGE cluster of sun-spots, so large that more than a dozen earths could be dropped into them, now sweeping across the face of the sun, is disclosed on photographs taken at the U. S. Naval Observatory. The current spots comprise the largest group seen in recent months. Three of the spots, with smaller satellite spots near-by, are lined up in an east-west direction across the sun. Not far away is a fourth group consisting of three small spots arranged in the form of a triangle. All passed the sun's meridian line about July 8 and should disappear off the western edge of the sun about July 15. If they keep their shape they should reappear again on the sun's eastern side near the end of July. The period of rotation of the sun, which determines the speed with which sun-spots appear to move, is about four weeks as seen from the earth.

AMERICAN aviation hangs up another first with the establishment of the world's premier "windmill airplane" airline, which has started shuttling airmail between Camden airport, the Philadelphia flying field and the Philadelphia post office. Not only does Eastern Airlines' "land-on-a-dime" Kellett autogiro haul 400 pounds of mail in five minutes a distance a mail truck requires a half hour to negotiate, but it promises a solution to the big city airport problem as well. The autogiro can land on the post office building roof. With mail now successfully carried, passengers will be carried later just as quickly and easily.

RADIO observations as to how the ionized layers in the earth's upper atmosphere reflect transmissions give a good index to the activity of the sun, according to W. M. Goodall, engineer of the Bell Telephone Laboratories. Comparing critical radio frequencies of what scientists call the F2 region of the ionosphere with astronomical observations of the calcium flocculi on the middle part of the sun, he finds both give measures of the sun's activity.

SPECIAL paints that change color when they are heated to definite temperatures are being used successfully in German airplane engine research. While temperature-indicating paints or "thermocolors" have been used previously, engineers of the I. G. Farbenindustrie at Oppau have developed a series of new paints that are reliable thermometers up to 825 degrees Fahrenheit. The exact compositions are not disclosed, although it is known that they are mostly metallic salts. Earlier thermocolor paints were effective only up to 150 degrees F. and the color change was not permanent. They consisted usually of double iodides of mercury and copper, or mercury and silver.

A NEW x-ray procedure which promises to help in the fight on tuberculosis was described by Drs. Israel Steinberg, George P. Robb and Ursula J. Roche, of New York City. The new method may enable doctors to determine the effect of lung collapse therapy, one of the new methods of treating tuberculosis, on the physiology of blood circulation in the lungs, and even to evaluate effectiveness of this treatment. "It seems certain," the inventors of the method said, "that many problems in pulmonary disease which previously have been studied only in animals or in autopsy material may now be investigated during life." The new procedure consists of injecting a concentrated solution of diodrast rapidly into the veins. This substance makes the veins opaque so they can be seen in the x-ray picture. Within a matter of seconds, the heart and the veins and arteries of lungs and chest of a normal person can be seen by this procedure. Striking decreases in the number of veins carrying blood away from the involved areas of the lungs were found to be characteristic of pulmonary tuberculosis. Other changes in the arteries of the lung were observed.

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SCIENCE NEWS

Science Service, Washington, D. C.

PARIS ASTRONOMICAL CONFERENCE ON STELLAR EXPLOSIONS

LIFE histories of the heavens' most mysterious stars, gigantic and brilliant stellar explosions that are believed to end as almost unbelievably dense but very dim stars, are being explored at an international congress of astrophysics in Paris, July 17–23, that brings together fourteen of the world's leading astronomers, seven of them Americans.

Novae, or "new stars," and white dwarf stars are the special subjects of this congress. Those participating were this week in Paris as guests of the unique Singer-Polignac Foundation, sponsored and financed by the heiress of the Singer fortune, the American-born Princess Singer-Polignac, in memory of her late husband, Prince Polignac, who had been conducting research in astronomy before his death.

Professor Henry Norris Russell, of Princeton University, is presiding over the conference. The other Americans are: Dr. Gerard P. Kuiper and Dr. S. Chandrasekhar, of the Yerkes Observatory; Dr. Walter Baade, of the Mt. Wilson Observatory; Dr. Sergei Gaposchkin and Dr. Cecilia Payne Gaposchkin, of the Harvard Observatory; Dr. C. S. Beals, of the Dominion Astrophysical Observatory at Victoria, and Amos J. Shaler, of the Massachusetts Institute of Technology, who is secretary and interpreter.

Sir Arthur Eddington and Professor F. J. M. Stratton, of Cambridge, England, the Chanoine Georges Lemaître, the Belgian cosmologist; Dr. B. Strömgren, of Copenhagen; Professor K. Lundmark, of Lund, Sweden; Professor Bengt Edlen, of Uppsala, Sweden, and Professor N. Grotrian, of Potsdam, Germany, comprise the European delegation.

The conference is attempting to clarify the life history of a star. It is believed at present that an ordinary star, such as the sun, eventually reaches the point where it no longer can give forth its quota of heat and light. Its internal equilibrium becomes so disturbed that some change must occur. This change may take the form of a sudden explosion. Such violent explosions of stars and even entire galactic systems have not infrequently been observed by astronomers—the star becomes what is called a nova, or a "new" star. After the star has suffered an explosion of this sort, and it has settled down to a new equilibrium, its internal structure is radically different. It is thought that those white dwarfs—faint stars of a type characterized by densities so great that, volume or volume, they are millions of times heavier than lead—are the end products of the cataclysms observed as novae.

THE SUPERNOVAE

DR. HENRY NORRIS RUSSELL, of Princeton University, in the address he expected to give at the opening of the Singer-Polignac Congress of Astrophysics on July 17, states that super-exploding stars, the supernovae, although they are the most tremendous phenomena known to man, constitute a mystery to astronomers.

There seems to be no escape, according to an advance copy of his address, from the conclusion that "a supernova may reach such amazing brilliance that it will shine for a few days with light comparable to that given off by a whole galaxy of stars. The fortunate recent discovery of two supernovae, one of the eighth magnitude, in time to permit detailed spectrographic observation, has greatly increased our information and also our puzzlement. The spectra, though similar from one supernova to another, are utterly unlike those of any other celestial bodies, so that despite careful study it has not yet been possible to identify a single feature with any radiation known in the laboratory."

Dr. Russell has not given up hope that the problem of the kind of light emitted by supernovae will be explained by known properties of atoms, perhaps atoms that are moderately ionized, that is, with not more than half-a-dozen electrons stripped from them. The energy emitted by a supernova is enormous, reaching as much as 50,000,000 times that of the sun. Two supernovae that occurred within the Milky Way, the galaxy in which the sun and earth are located, are authenticated. These are famous Tycho's star of 1572, the brightest ever observed visually, and one recorded in China and Japan in 1054, which survives as the nucleus of the Crab Nebula, which itself represents the material ejected during the cataclysm.

There are lesser exploding stars, the ordinary novae, which are now occurring with extraordinary frequency. Six very conspicuous novae have appeared during the first forty years of this century, an unequaled record. This happy accident—for astronomers—Dr. Russell attributes to the chance of our position in space because the actual dates of the outbursts differed by many centuries due to the differences in distance from the stars to the earth.

MEASURING THE CURRENT IN LIGHTNING BOLTS

ATOP the 42-story tower of the University of Pittsburgh's Cathedral of Learning there is a spinning wheel that traps bolts of lightning, studies their electrical characteristics and then discharges them harmlessly through lightning arresters. The device spins at 3,400 revolutions a minute. In continuous operation since June 3, it turned over its 210,000,000th revolution on July 16. In a normal lightning season of 200 days it will come close to a billion revolutions.

The device that willingly and purposely awaits the direct hits of lightning is called the fulchronograph. Designed by Charles F. Wagner and Gilbert D. McCann, Westinghouse engineers, it is essentially a motor and a slotted aluminum wheel filled with laminated permanent magnet steel, projecting like fins from each side of the wheel and rotating through two coils which carry the total surge current from the lightning stroke being measured. As the small fins pass between the magnetic field of the coils they are magnetized in proportion to the amount of current that is carried by the lightning stroke in time intervals as brief as forty millionths of a second.

The fulchronograph gives a schematic picture of the wave shape and surges in a single lightning stroke. This

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The great interest in Beaumont, the pioneer physiologist, required the reprinting of Dr. Jesse Myers' book. New material has been supplied by Dr. F. A. Coller and Dr. A. C. Ivy. The book includes much data regarding the case of Alexis St. Martin.

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is compared with the wave shape and surges created by artificial lightning bolts in the laboratory, and can be used to improve the protection of exposed power circuits.

The first lightning stroke actually measured by the fulchronograph was found to last one sixtieth of a second and showed a maximum current of 21,000 amperes, or enough to light 40,000 ordinary light bulbs.

CORRECT EATING

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VICTORIES over disease in the past have been won for us by others. Future victories will depend increasingly upon oureslves, our willingness to change our food habits and eat what is good for us, was pointed out by Dr. Victor G. Heiser, of New York City, in the eighth Maiben Lecture, delivered at Milwaukee before the recent meeting of the American Association for the Advancement of Science.

"In the past the extraordinary success in liberating man from the pestilential diseases has been achieved largely in the field of environmental sanitation. No great change has been required in man's personal habits. Typhoid fever and cholera have been controlled through the engineer providing man with safe water. He has been saved from plague by keeping rat fleas from him. Smallpox and diphtheria have been made puny enemies by vaccination, and malaria and yellow fever can also be prevented by community effort."

Now, however, man is confronted with the challenge of increasing his own welfare by his own efforts. Are we, Dr. Heiser asked, ready as whole peoples to wean ourselves away from tradition and custom and learn how to eat our own way to better health? Many of us voluntarily deny ourselves certain foods for religious reasons; we are conscientious vegetarians or we eat no pork or we abstain from meat on certain days. Will we do that kind of thing for the sake of our health?

The answer is not easy, the speaker admitted. He told of the dramatic demonstrations of the role of polished rice in producing the disabling disease, beriberi, among the millions of the Orient, of the equally dramatic disappearance of that plague from groups fed on the unpolished grain. Yet Orientals still blandly persist in their preference for polished rice—and still get sick with beriberi. And vast numbers of our own countrymen suffer needlessly from pellagra because of a similar dietary stubbornness.

A really enlightened diet will not only prevent the so-called deficiency diseases, it will ward off many of the conditions that now-a-days make surgical operations necessary. He told of large-scale experiments with colonies of white rats, which lived in perfect health as long as they were given a physiologically adequate diet, but which, when placed on rations of what might be called the "civilized poverty" level, proceeded to develop such surgical conditions as sinus trouble, infection of the middle ear, gastric ulcer, kidney and bladder stones, gangrene, heart diseases and bad teeth.

Correct eating need not be expensive eating, Dr. Heiser urged: "All too often we eat far too much of a substance that is not needed, and still suffer from hunger if a needed substance is not present in sufficient quantity."

FRANK THONE

ITEMS

WHATEVER federal funds are allotted to tuberculosis control, a large proportion should go for training personnel, is the belief of Dr. Chesley Bush, of Livermore, Calif., as stated in his presidential address before the National Tuberculosis Association at Boston. Not the least of this training of personnel, he said, should be training in medical administration of institutions. In the fight against tuberculosis, prevention and treatment go hand in hand, he pointed out. For example, an operation to put the infected lung at rest may arrest the patient's disease but it also prevents the spread of infection. Similarly a family survey may detect a minimal case of tuberculosis and make this lung operation unnecessary.

NEUTRAL atomic fragments by the billions, 1,000 times more plentiful at thirteen miles overhead than at sea-level, give the first clue to a new kind of atom smashing, Dr. S. A. Korff, of the Bartol Research Foundation of the Franklin Institute, suggested to members of the American Physical Society. The fragments are neutrons, atomic particles without electrical charge that have amazing ability to pierce all atoms. Sending a new type of neutron detector 70,000 feet up in unmanned balloons, Dr. Korff found that while cosmic ray intensity was increasing 100 times over sea-level intensities the neutron intensity was increasing by 1,000 times. Explaining the origin of the stratosphere neutrons, Dr. Korff said: "If a cosmic ray collides with a nitrogen nucleus and completely disrupts it, seven neutrons will be liberated. The presence of neutrons may be an indication of some such explosion induced by cosmic rays in our atmosphere. Cosmic rays are the only agency with sufficient energy to produce such a disruption. Possibly these neutrons are the clue to an important new atom-smashing process."

A BILLION times a second, on the average, a molecule in a gas at ordinary pressure and temperature will collide with another, was reported by Dr. Eugene P. Wigner, of Princeton University, to the American Chemical Society symposium at Madison, Wis., on the kinetics of homogeneous gas reactions. Despite this large number of collisions all chemical reactions in gases are not instantaneous, because not every "bump" between molecules leads to a chemical change. A great many molecules are moving slowly and have too little energy. A certain threshold energy exists below which molecules will not react. This is known as the activation energy. Another reason for the lack of reaction when molecules collide, Dr. Wigner added, is that they may have too much energy. This excess energy may disrupt the newly-formed compound.

Now adapted for household refrigerators are the new ultraviolet producing lamps which will kill bacteria and keep mold growth under control. The lamps developed by the Westinghouse Electric and Manufacturing Company for hospital operating rooms and the preservation of meats in stores are available as a 1939 refrigerator accessory. They burn only a fourth as much electricity as a small 25-watt bulb.

NEW BOOK AND INSTRUMENT CATALOGUES

APPLETON-CENTURY, D., COMPANY, New York. *Fall Books, 1939.* Pp. 66.

BAKELITE CORPORATION, New York. *Bakelite Review;* "Give Your Sales the Needle!" *July, 1939.* Pp. 15. Illustrated.

BAUSCH AND LOMB OPTICAL COMPANY, Rochester. *Bausch and Lomb Microtomes and Accessories; Catalog D-16.* Pp. 15. Illustrated.

BELL AND HOWELL COMPANY, Chicago. *Filmo Topics; Vacation, 1939.* Pp. 12. Illustrated.

DUTTON, E. P. AND COMPANY, New York. *Dutton Books; Summer, June through September, 1939.* Pp. 24. *News of Books and Authors; July–August, 1939.* Pp. 8. Illustrated.

GENERAL ELECTRIC COMPANY, Cleveland. *Engineering Data on Fluorescent Mazda Lamps; June 1, 1939.* Pp. 16. Illustrated.

GOLDSCHMIDT, E. P. AND COMPANY, LIMITED, London. *Catalogue 52, Old Books; A Collection of Early Photographs and Books Commemorating the Centenary of Fox Talbot and Daguerre, 1839–1939.* Pp. 80. Illustrated.

LEEDS AND NORTHRUP COMPANY, Philadelphia. *Mueller Bridges for Highly Precise Measurements of Temperature; Catalog E-33C (1), 1939.* Pp. 16. Illustrated.

LEITZ, E., INCORPORATED, New York. *Leica Photography; June, 1939.* Pp. 26. Illustrated. Price, $0.10.

MAICO, INCORPORATED, Minneapolis. *Maico Model D-5 Audiometer; a Precision Instrument for the Measurement of Hearing Loss.* Pp. 8. Illustrated.

OXFORD UNIVERSITY PRESS, New York. *Bulletin of New Publications; April and May, 1939.* Pp. 16. Illustrated.

QUARITCH, BERNARD, LIMITED, London. *A Catalogue of Books on Botany; Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Tobacco; No. 563, 1939.* Pp. 100.

WHITTLESEY HOUSE (McGRAW-HILL BOOK COMPANY), New York. *1939 Fall Books.* Pp. 32. Illustrated.

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SCIENCE NEWS

Science Service, Washington, D. C.

VITAMIN B

PROFESSOR C. A. ELVEHJEM, of the University of Wisconsin, discoverer of pellagra-curing nicotinic acid, the third B vitamin, reported to the chemical research conference, which was held at Gibson Island, Md., under the auspices of the American Association for the Advancement of Science, that Vitamin B has now been chemically sliced into ten different vitamins or factors and that the end is not yet in sight. He stated that the boundaries of the B complex are still unknown. The B complex is "the group of water-soluble vitamins found in yeast." Liver and whole grains are also richly supplied with this vitamin.

Oldest of the B vitamins is the chemical now known as thiamin, which prevents and cures the nerve disorder, beriberi. Next in line is riboflavin, recently discovered to be essential for human health, but known much longer as one of the B vitamins through discoveries of the dire effects on laboratory animals of a lack of this substance. Nicotinic acid, preventive and cure for pellagra, was the third B vitamin to be cut out of the group by chemical dissection.

The spectacled eye factor is the picturesque way Professor Elvehjem described one of the newest members of the B group. Rats lacking this vitamin develop the condition described as spectacled eyes. Pantothenic acid, acclaimed recently as a vitamin essential for all living forms, is the same vitamin that prevents a skin disorder in chicks. The anti-gray hair member of the B group is apparently a rat vitamin only. Another rat vitamin is B_6, also called Factor 1, and fortunately is now identified chemically and available in synthetic form. The chemical identification is fortunate because it helps to clear up some of the confusion about these vitamins. Factor W, for rats, and Factor U, for chicks, and another substance known at present as vitamin M, apparently complete the list of the 10 B vitamins so far known.

How many and which of them, outside of thiamin, riboflavin and nicotinic acid, are essential in the diet has not been entirely settled. The difficulties of chemical separation of the B vitamins from each other suggests that people eating plenty of the food sources, such as whole grains, liver and other fresh meat, and yeast, can not fail to get all the B vitamins.

The members of the group already available as chemical substances, thiamin and nicotinic acid, for example, are valuable for patients too sick to eat and assimilate the vitamin-containing foods.

FROZEN SLEEP

FROZEN sleep may replace ether as anesthetic for surgical operations of the future. Instead of putting a smelly mask over the patient's face and telling him to "breathe deep" the surgeon of to-morrow may gently chill his patient to insensibility before getting to work with scalpel and needles. After the operation is over, the patient will be warmed back to consciousness without any unpleasant anesthetic after-effects.

Scientific evidence that this picture of future surgical operations is a distinct possibility appears in a report from Dr. G. H. Parker, emeritus professor of zoology of Harvard University. In an article in SCIENCE he states that frozen sleep has long been used in the Harvard laboratories for operations, even extensive ones, on fishes, amphibians and reptiles.

Use of the same method of inducing unconsciousness before operations on humans is suggested, Dr. Parker says, by "press reports of a kind of cold hibernation induced in human beings by a slight lowering of their bodily temperatures." This refers to the use of cold hibernation in treatment of inoperable cancer reported by Drs. Temple Fay and Lawrence W. Smith, of Temple University, Philadelphia, to the American Association for Cancer Research and the American Medical Association in April and May of this year. Without advocating the method as a cancer cure, but only as an aid in treatment, interest was aroused by the achievement of safe hibernation in humans through refrigeration methods which cooled the body three to four degrees below its normal temperature of 98.6 degrees Fahrenheit. Of the many investigators whose interest was aroused by reports of this use of frozen sleep, Dr. Parker is apparently the first to go on record with a practical suggestion for its use in fields other than cancer treatment.

The Harvard method of inducing frozen sleep, as Dr. Parker describes it, is similar to that used by cancer patients. At Harvard the fishes or reptiles are immersed for 10 to 15 minutes in water and cracked ice or cracked ice alone. They are then laid on cracked ice for the operation.

The Philadelphia doctors put their patients in a room cooled to about 50 degrees Fahrenheit, used an air-conditioning unit to keep the body temperature below 95 degrees Fahrenheit, and surrounded patients with ice bags and coils in which ice water circulates. The patients were kept in this frozen sleep for several days. Before turning on the cold, however, the patients were put to sleep with sleeping medicines.

The animals at Harvard, Dr. Parker says, recover quickly and satisfactorily from their frozen sleep at the ordinary temperature of the laboratory and "the animals so treated may be almost at once tested in a particular way without waiting for the gradual disappearance from their systems of an anesthetizing drug."

SPECTROSCOPICAL ANALYSIS OF VIRUSES

THE first spectroscopic analysis of viruses, ultra-microscopic disease-producing entities, and their constituent proteins and nucleic acids, has been made by Dr. George I. Lavin, of the Rockefeller Institute for Medical Research.

Dr. Lavin investigated three plant viruses—the classic tobacco mosaic virus, the latent mosaic virus and the tobacco ringspot virus, all of them crystallized in the pioneer researches in this field by Dr. Wendell M. Stanley and Dr. Hubert S. Loring of Princeton.

The crux of his technique, as explained at the Conference on Spectroscopy at the Massachusetts Institute of Technology, was the use of a continuous light source, in preference to the more usual source, and fractionation or splitting of the complex biological substances with which he was dealing, a procedure which may well revolutionize accepted spectroscopic methods of attacking intricate medical and biological problems.

Nucleic acid is apparently a rather prominent constituent of some viruses at least, for Dr. Lavin found it in all three of the plant viruses with a particularly high concentration in the tobacco ringspot. The presence of indoleacetic acid was also indicated.

That the amino acids which go to make up a protein may at times be hitched together in a very peculiar way was indicated by Dr. Lavin's study of papain, a protein-splitting enzyme, in which he was unable to find the amino acid, tyrosine, until after the enzyme had been hydrolyzed by Dr. J. S. Fruton.

He has also used the spectrograph to analyze urine, photographing fractions prepared by Drs. K. Dobriner and C. P. Rhoads so precisely that he was able to identify a number of physiologically important materials. Two years ago he made the first spectroscopic analysis ever done of an enzyme, pepsin.

In all, Dr. Lavin has investigated proteins both containing and deficient in aromatic amino acids and with varying concentrations of nucleic acid, problems which are virtually hopeless chemically. He has also examined the protein fraction of pneumococci, the causative agents of pneumonia.

SPECTROSCOPIC STUDIES OF HEMOGLOBIN

THE first studies ever made of hemoglobin, the red, oxygen-carrying material of the blood, within its natural environment of the red blood cells themselves, were reported to the Conference on Spectroscopy by Dr. David L. Drabkin, of the University of Pennsylvania.

Previous spectroscopic researches in this knotty but highly significant field have been limited to investigations of concentrated solutions of the pigment, prepared by actual destruction of the red cells themselves. Thus much of our knowledge has been drawn from studies not of the substances in their natural environment but of their solutions obtained by extraction, a procedure possibly risking chemical change.

Dr. Drabkin dealt with a rather complicated turbid suspension of the red blood cells which gave a distorted picture requiring interpretation. His results constitute the first accurate deductions ever made on biological material. Preliminary studies indicate that the spectra of hemoglobin and its derivatives are the same within the blood cells as those obtained extracellularly.

The method has already found an additional application, in facilitating accurate determination of hydrogen ion concentration within the red blood cells. This is done by intracellularly converting the hemoglobin to methemoglobin, its oxidized form, and using the well-known indicator properties of this latter compound. Dr. Drabkin said that this unique method of using the main cellular constituent to determine reactions within the cell appears "most promising." Heretofore such methods as puncturing the cell with a micro-needle, which injures the cell, have been used.

Dr. Drabkin also reported progress in a spectroscopic study of protein denaturation which may throw considerable light on the structure of the complex protein molecule. Urea, he found, may play an important role in the denaturation process, for whereas hemoglobin is denatured no more rapidly in alkali than in concentrated urea solution, the presence of both reagents speeds the process some sixty-fold.

THE WING BEATS OF INSECTS

STUDIES of the almost incredibly fast beatings of insect wings, in some cases as high as 350 strokes per second, are in progress at Harvard's Biological Laboratories as the first step in a comprehensive research program aimed at understanding the physiological processes which sustain this exceptionally vigorous activity.

The investigation, directed by Dr. Leigh E. Chadwick, is aided by the high speed stroboscopic and photographic technique perfected by Professor Harold E. Edgerton, of the Massachusetts Institute of Technology. With exposures as fast as a 25,000th of a second, sharp, stop action photographs can be obtained of the whirring wings or the insects can be observed visually, either stopped altogether, at slow motion or even in reverse.

Outstanding among Dr. Chadwick's preliminary findings is the first conclusive answer to an old scientific argument, whether the speed of the wing beat varies among species, among individuals of the same species or even in the same individual under different external conditions. Dr. Chadwick finds there is considerable variation in all these cases.

Different individuals of his most useful subject, drosophila the fruit fly, for example, vary in wing speed from about 9,000 beats per minute to possibly 13,000 under normal conditions. Increasing temperatures skyrocket the rate from 6,000 at 50° Fahrenheit (10° Centigrade) to double that at 84° F. (29° C.) Fatigue naturally lowers the rate, even at high temperatures, but the fruit fly can usually manage two or three hundred thousand strokes before exhaustion.

Wing speeds of moths and butterflies also vary widely among different species. The common big yellow swallowtails, for example, average about six beats a second, while hawk moth speeds run as high as 90 per second. The honey bee averages between 160 and 220 per second, the bumblebee, 240, the common house fly about 160. Dragon flies, at 30 per second, have the peculiarity that the rear set of wings precedes the front set in the beating, in contrast to the case for other types of insects.

To appreciate these tremendous speeds, compare them with high-speed physical exercises of other animals: man can do a fast one-finger piano trill at about 10 beats per second; the leg of a scratching mouse does about 20 per second; the wings of a hummingbird, much too rapid to be seen, go about 50 beats per second.

Dr. Chadwick is also studying the effects of atmospheric pressure on wing-speeds and correlating his findings with

oxygen consumption as a clue to internal physiological activity. Associated with him in the study are three research students, Carroll M. Williams, Darcy Gilmour and O. P. Pearson.

THE NEW COURSE OF THE YELLOW RIVER

THE treacherous, silt-laden Yellow River, "China's Sorrow," will go on a flood rampage in a few weeks in the no man's land between contending Japanese armies and Chinese guerillas which will exceed the war in destructiveness, Norman D. Hanwell, of the American Council of the Institute of Pacific Relations, predicted. He stated that the river's new course, which it carved out for itself last year in one of its periodic shifts, is too small to take care of the flow of water from summer rains. Twelve million people in the province of Kiangsu, in one corner of which Shanghai is located, will eventually be dispossessed and forced to move because the land on which they live is below sea level and is also in the river's way.

"There is little hope that the river can be returned to the bed from which it so recently fled," according to Dr. Hanwell. "On former occasions efforts to force the river back to its 'proper' bed were under way long before it was able to form a definite new channel of its own. In addition, those charged with the responsibility of controlling the rampant river had certain facilities at hand which are no longer available. Access to transportation facilities and materials necessary for curbing the river are now cut off by the war. The most serious breach remains, it is reported, in the 'no man's land' between the Japanese and Chinese 'lines.' So long as hostilities continue . . . it appears unlikely that effective countermeasures can or will be taken to avert an otherwise almost inevitable catastrophe."

Last year the Yellow River caused enormous destruction when it changed its course, usurped the beds of two other rivers and ended up by flowing through the Grand Canal into the Yangtze River. The Yangtze, itself in flood due to melting western China snows and dykes cut by fighting armies, backed up and overflowed Lake Poyang as a result.

ITEMS

ADMINISTRATOR CLINTON M. HESTER, of the Civil Aeronautics Authority, said in an address at St. Louis that airlines of the United States hung up an all-time year-round safety mark of 42,000,000 passenger miles per passenger fatality during the year ending June 30. While the nation's domestic lines were piling up 630,000,000 passenger miles, only 15 passengers lost their lives in four accidents. Mr. Hester's figures do not include American flag lines operating abroad. The best previous year-round record is about a third as good.

THE U. S. Antarctic Service, the newest government bureau, denied that its first project, the forthcoming Federal expedition to the Antarctic, is being made to claim South Polar region lands for the United States. It is stated by Roger Hawthorne, its press representative, that the expedition is being made for purposes of exploration and study. Land can be claimed only by formal proclamation of the State Department. The expedition will, however, make reports of its findings upon which the department may wish to act. The new Federal agency, of which Admiral Byrd is executive officer, has no definite plans beyond the expedition, although it is expected to be a semi-permanent government bureau. It may station men in the Antarctic for the next several years if the expedition and the status of international claims for the region make it advisable.

A NEW highly purified diphtheria antitoxin, developed in England, is reported in the *Journal* of the American Medical Association. Animal experiments indicate that this refined antitoxin is more rapidly and completely absorbed from subcutaneous tissues than is the American antitoxin. The Wellcome Laboratories, England, have developed a method of large-scale purification of diphtheria antitoxin based on a fractional enzymic action. "The possibility that such enzyme purifications may be generally applicable to antiserums demands prompt investigation," according to an editorial appearing in the *Journal*.

BEES will fly in Russian greenhouses to pollinate flowers just as they do out of doors, according to Tass, the Soviet telegraphic news agency. Experiments in the greenhouses of the Agricultural Exhibition of the Soviet Union showed that when bees were used for the pollination of hothouse cucumbers the crop was increased by forty per cent. over that obtained through the hand-pollination method.

THE first studies of remote interstellar "atmosphere" were announced at the meeting of the American Association for the Advancement of Science in Milwaukee by Dr. Otto Struve, director of Yerkes Observatory and of the new McDonald Observatory in Texas. It was at the latter institution that the studies were made, with a powerful new instrument known as the nebular spectrograph. Three-hour exposures were necessary, using specially sensitized photographic plates, to get "snapshots" of the faint glow of these gases of space, split up into the lines that tell of their chemical nature. Sixty-five such spectral photographs have been made. These gases, and indeed all kinds of drifting matter in the deeps between the stars, are of course very thinly spread out. Dr. Joel Stebbins, of Washburn Observatory, stated that light traveling through one mile of the earth's atmosphere loses more of its intensity than it would in passing through a quadrillion miles of interstellar space.

A STAR that periodically half hides itself behind a puff of smoke, like an automobile with a dirty, soot-choked muffler, was described by John A. O'Keefe, of the Yerkes Observatory, at the recent meeting of the American Association. This star, an inconspicuous member of the constellation Northern Crown, is a variable, that is, it undergoes periodic fluctuations in brightness. Five years ago another astronomer, E. Loreta, suggested that the star produced its own dimmings by puffing out clouds of obscuring matter. Mr. O'Keefe's studies indicate that these clouds are probably composed of carbon dust—in effect, smoke. The star apparently expels the carbon in the state of a vapor or gas, which speeds out to a distance of about four times the star's diameter and then condenses into solid particles.

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SCIENCE NEWS

Science Service, Washington, D. C.

A VACUUM TUBE OF LONG LIFE

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A VACUUM tube that will give nearly eleven and a half years of continuous service, night and day, has been developed by Dr. A. W. Hull, of the General Electric Company. The tube, setting a new high in length of life for vacuum tube devices, is a mercury vapor thyratron which is used to convert alternating current into direct current. Tubes of this type carry very large electrical currents and can be used as commutators for direct current motors such as in elevators. They also are employed in experimental methods of power transmission by direct current.

The new tubes exceed by 100 per cent., in their probable length of life, the famous 50,000-hour tubes which early this year gained public notice by investigations of the Temporary National Economic Committee in Washington. Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, was questioned by the committee about the vacuum tubes, giving 50,000 hours of useful service, which were employed by the telephone company as "repeaters" on its long-distance telephone lines.

High-cost precision construction explained the long-life of the telephone tubes. It was disclosed that while they were adaptable to the average radio set they would outlast the set several times and that the set would be obsolete long before its tubes were worn out. Their higher cost rendered them economically impracticable for ordinary radio use.

Dr. Hull's new vacuum tube owes its long life, in contrast, to a new type of cathode which emits the electrons within the tube. Ordinary cause of tube failure, he explains, comes because the electron-emitting material on the cathode (barium oxide) is gradually used up and finally fails. In the new Hull-type of thyratron there is built inside the tube a reservoir of the active electron-emitting material. Known as a "dispenser cathode" this reservoir serves the dual function of a heater (to make the electrons go off) and as a dispenser of the coating. Some of the new type tubes have been in experimental service for 30,000 hours, or nearly three and a half years.

One tube, accidentally broken at about 20,000 hours, was examined. It was found that less than half of the barium oxide supply had left its container at that time and that half of this half was still within the cathode enclosure doing its job of emitting electrons. This means that 20,000 hours is probably less than a quarter of the life of the tube. This is the reasoning behind the statement that the tubes may last 100,000 hours or nearly eleven and a half years of continuous service, 24 hours a day.

The thyratrons under test are carrying very high currents, 175 amperes, but have not yet shown any deterioration of their vacuum. The new tube is described in the current issue of the *Physical Review*.

STAINLESS STEEL

THAT the Achilles heel of stainless steel—its inability to resist the corrosive action of sea water—may be protected by the addition of tiny traces of silver, has been discovered at the Massachusetts Institute of Technology.

The new discovery, which should have great importance in marine and naval construction, arose from observations that a salt of silver, silver chloride, is insoluble in sea water. Out of this knowledge Professor R. S. Williams and his associates have found that as little as 0.42 per cent. of silver will cut down stainless steel's salt water corrosion more than 80 per cent. Not only is corrosion resistance improved, but the heat conductivity of stainless steel—another weak point—is increased 26 per cent. by the addition of only .14 per cent. silver, according to the report of Arthur D. Little, Inc. Other advantages claimed for silver-steel is a greater ease of machining and an improved polish. A very uniform and highly polished surface in itself inhibits corrosion. The corrosion of stainless steel in sea water comes from tiny electrical batteries created on the surface of the steel plate by differences in oxygen concentration. A barnacle, on a ship's bottom, for example, might be the cause of this oxygen difference. In the myriad of tiny batteries created by this or a similar process, the formation of chloride compounds of the metals in the alloy is favored. These chlorides are soluble and wash away, leaving a pitted surface. As the pits deepen the difference in concentration of oxygen increases and the corrosion goes faster and faster until the entire plate of stainless steel becomes honeycombed. To the eye its surface may look unmarred but at the danger point it may suddenly collapse.

The function of the silver in the alloy is to make insoluble chlorides under the action of sea water which form a thin, guardian layer.

THE MATERNAL DEATH RATE

THE death rate from childbirth in the United States is falling spectacularly. While there is much that can and should be done to improve American obstetrics, the situation is by no means as unfavorable as both the public and the medical profession have been led to believe.

The *Journal* of the American Medical Association recently published "an obstetric audit" made by Dr. Scott C. Runnels, of Cleveland, secretary of the Hospital Obstetric Society of Ohio.

The black picture of the maternal death rate in the United States, exceeded only by that of Chile and Scotland, has been much publicized. Dr. Runnels's audit shows that the charge that American hospitals are unsafe places in which to have a baby certainly does not apply to all hospitals. It further shows that the charge that preventable sepsis is rampant is, to say the least, "a flagrant misrepresentation." While deaths from all causes declined between 1929 and 1937 by 7 per cent., the puerperal death rate declined 30 per cent. Hospitals and obstetricians have, therefore, made tremendous strides.

Dr. Runnels makes a careful distinction between the puerperal death rate and the obstetric death rate. In the former are included abortions and ectopic (tube) preg-

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nancies. Neither of these situations can be charged against the obstetrician or the hospitals. Yet almost half of the deaths commonly classified as due to puerperal septicemia are due to abortion.

Localities show sharp variability in puerperal death rates. In 1938, for instance, the maternal mortality for the states ranged from a low of 25 per 10,000 births in Connecticut to a high of 92 in Nevada, a rate almost four times as great. Twelve states had a rate below 40; ten had a rate above 60. In cities the maternal death rate is higher than in rural areas. Dr. Runnels's audit attributes this fact to the influx of non-resident patients who are taken to city hospitals when serious conditions develop. The same explanation is given of the fact that the hospital puerperal death rate is higher than the home rate. When serious complications develop during labor at home, the patient is whisked off to the hospital.

In commenting on the decided and accelerated strides in the reduction of maternal mortality, Dr. Runnels concludes the following: "Supervision by the hospital of the character of obstetrics practiced within its walls and the enforcement of early consultation in the case of abnormal labor has become recognized as essential. As the births of the United States increasingly occur in well-organized hospitals and come increasingly under the supervision of trained obstetricians, maternal mortality and morbidity will continue to improve. If obstetric conditions were as favorable over the entire United States as are those existing to-day in a quarter of the country, there would be an annual saving of 2,500 lives."

THYROID GLANDS KEPT ARTIFICIALLY ALIVE

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A NEW lead for an attack on the kind of goiter known as Graves's disease has been obtained from human thyroid glands kept alive on artificial medium outside the body for the first time for from three weeks to two months in the Lindbergh-Carrel heart apparatus. The studies may revolutionize the treatment of this kind of goiter, characterized by popping eyes. They are reported by Drs. N. Chandler Foot, Lillian E. Baker and Alexis Carrel, of the Rockefeller Institute for Medical Research and Cornell University Medical College and New York Hospital, in the current issue of the *Journal of Experimental Medicine*.

The thyroid glands were taken from patients operated on for Graves's disease. The glands were immediately placed in fruit jars, the covers were clamped on, the jars wrapped in sterile cotton, and then whisked from the hospital to the neighboring Rockefeller Institute. There the glands, after preliminary treatment, were placed in the apparatus designed for Dr. Carrel by Colonel Charles E. Lindbergh. They were nourished on solutions or media instead of blood. Different kinds of solutions were tried, but the glands, it was found, could be kept alive and healthy for weeks on a completely artificial, synthetic solution which contained only a tiny amount of blood serum, just enough to act as a solvent for vitamin A.

A remarkable cancer-like change occurred in one of the glands during the six to eight weeks that it remained in the apparatus. The change was great enough to deceive a competent thyroid surgeon who examined sections of this gland into thinking the sections were from cancer tissue. No reason for this change was found, and after about one month, the gland became more normal looking.

A hint that the serious thyroid gland disorder, Graves' disease, may be due to some condition quite outside the gland was found in studies of the human glands in the Lindbergh-Carrel apparatus. The changes in the gland that appear in Graves's disease were increased and intensified when small amounts of extracts from the cortex of the adrenal glands and from the pituitary gland were added to the nourishing solution on which the glands lived in the Lindbergh-Carrel heart. Thyroid gland hormone itself, female sex hormone material, adrenalin and insulin were also tried, but produced changes only in connection with the adrenal cortex hormone and the pituitary hormone.

Dr. Baker, in response to a Science Service inquiry, said that "It is too early to say whether Graves's disease is a matter of something other than the thyroid gland." At present she is more concerned with the fact that human organs can be kept alive for long periods in the apparatus.

One of the great advantages of the method is that the organs can be kept alive on artificial media for long periods, during which the effect of the continuous action of small amounts of gland extracts and other chemicals can be studied. "Such experiments are probably of the utmost importance," Drs. Baker and Carrel state, "since this may be the way that certain profound changes are produced within the body."—JANE STAFFORD.

A NEANDERTHAL SKULL FOUND IN CAVE NEAR ROME

FOLLOWING its discovery in a cave at Monte Circeo, promontory on the Tyrrhenian Sea, fifty miles south of Rome, the world's most perfectly preserved specimen of Neanderthal skull is being studied by Professor Sergi Sergi, head of the Institute of Anthropology at the Royal University of Rome, in an effort to uncover new racial characteristics of this early man.

Both Professor Sergi and Professor Alberto Carlo Blanc, who first identified the skull on the scene of the discovery, say that it is in an almost perfect state of preservation except for a fracture in the right temporal area. This was caused by a series of blows on the head, probably during a battle with clubs, 70,000 or 80,000 years ago.

In addition to the anthropological importance of the skull, which is the third of its type found in Italy, fossilized bones of animals discovered in the cave give evidence of Neanderthal man's mode of life. The bones include fragments of those of prehistoric elephants, rhinoceri and giant horses, all showing evidence of fractures. The floor of the cave was literally paved with these bones.

Discovery of the cave was made by accident on the property of Antonio Guattari, owner of a small resort hotel at Monte Circeo. While digging foundations for enlarging the hotel, workmen found the entrance which had been sealed as the result of a landslip, believed to have occurred during the last glacial period, about 80,000 years ago. The skull was found in a large open space at the end of a passage in a crude circle of stones. It had lain there untouched for all these thousands of years. Guattari notified Professor Blanc, who completed the investigation, and brought the skull to Rome. Failure to find any bones of the skeleton leads to the belief that

the skull may have been brought to the cave and possibly used in a sacrificial ritual. Other bones found on the floor have been identified as those of bears, deer, panthers, goats and hyenas.

According to Professor Blanc, scores of caves and grottoes in the Monte Circeo area were formed when the sea was thirty to forty feet above the present level, and its action scooped out hollows in the soft rock. At the beginning of the last glacial period the formation of ice fields caused the sea-level to drop. It was then prehistoric man found the dry grottoes and began living in them. Slowly a new change of climate took place causing sudden rises and drops in temperature. Alternating periods of freezing caused splitting of rocks and landslips, burying the caves under masses of stone and earth. In the post glacial period, melting of ice caused the sea to rise again, washing away the earth in many of the grottoes, but failing to reach the height of the cave of the Neanderthal skull, leaving it sealed until the accidental discovery.

Following the finding of the skull, the cave was closed by the Italian Paleontological Society, but exploration will be continued in the fall after assembling and cataloguing the bones taken out during first excavations. Two other Neanderthal skulls have been found in Italy, one in 1929 and the other in 1935, both in the Sacopastore region, near Rome, but neither is as well preserved as the new discovery. However, the occipital opening at the base of one of the skulls was particularly well preserved, enabling Professor Sergi, of the Royal University, to establish for the first time that Neanderthal man walked erect, and not with an ape-like posture with head thrust forward as previously believed. The horizontal plane of the opening in the skull shows that the bones of the neck fit perpendicularly into the opening, causing posture to be erect, as in present-day man.

ITEMS

Discovery of a comet by an amateur French observer named Rigollet was bulletined to American observatories by Harvard Observatory on the receipt of data from the International Astronomical Bureau of Copenhagen. It is eighth magnitude and located near the horns of the constellation Taurus at right ascension 4 hours, 54 minutes; north declination, 26 degrees. It is moving about four degrees northeast daily and can be seen in the eastern sky just before dawn with a small telescope.

The Navy's study to determine if Anastasia Island, near St. Augustine off the Florida Coast, will be useful as a site for a new naval observatory has disclosed that it has already been used for astronomy on at least one previous historic occasion. On the top of old Fort Marion on the island is a plaque, showing that French army officers there observed a transit of Venus on December 6, 1882. Transits of Venus can occur only four times in 243 years, according to Captain J. F. Hellweg, superintendent of the U. S. Naval Observatory, who studied the old French marker.

Alaskan Eskimos have already been set to work by the division of Arts and Crafts of the Office of Indian Affairs making mukluks—reindeer fur boots—and parkas or fur hoods for members of the forthcoming U. S. Antarctic Expedition. Sailmakers in Boston are also at work on clothing made of tight-woven cotton airplane fabric which is both wind-resistant and light in weight. The Antarctic Service, which is organizing the expedition, reports that the Eskimos are being paid for their work out of funds for the expedition. The Indian Office regularly employs them in making similar garments. Other clothing for the expedition will come from War Department stocks or will be bought from the open market. Leather ski boots are to be used for traveling. The men will wear long flannel underwear during the entire year they are in the Antarctic.

The Chinese Government is getting aid from the League of Nations in its fight against plague, cholera, malaria and other epidemic diseases, the League's Health Organization announces from Geneva. Experts in the fight against plague and cholera are now working in the northwest and center of China, according to Dr. M. D. Mackenzie, who has just returned from China where he has helped arrange for the assistance of the league to the Chinese Government. The league has established a transport service to provide these experts with the stores they need for the fight against plague and cholera. Health conditions on the road to Burma, China's life line at present, are under the supervision of a league expert who is serving as technical adviser to the Chinese Government. Malaria is particularly malignant in regions traversed by this road and constitutes a serious menace to the transport workers, the road menders and the regions to which the road leads. Much of the work of the medical and engineering experts has been concentrated on this road, at the request of the Chinese Government.

Specific chemical remedies, such as sulfanilamide, will be available in the future for practically all the common infections on germ diseases, was predicted by Dr. E. H. Northey, of the Calco Chemical Company, at a special research conference of chemists on Gibson Island, Md. Sulfanilamide itself and its derivatives have proved successful against a wide variety of diseases of bacterial origin, including blood poisoning, abscesses and sore throats where they are caused by streptococci; the venereal diseases, gonorrhea and chancroid; meningitis; erysipelas; and, most important from the viewpoint of mortality, pneumonia. Chemicals derived from sulfanilamide now under test show promise of value against tuberculosis and virus diseases, the latter being the group which includes infantile paralysis and influenza. Sulfanilamide derivatives reported by chemists working to produce new and better chemical remedies of this sort now number 778.

Identification of three previously undetected molecules of matter, which can probably soon be found in the sun, was announced to the conference on spectroscopy at the Massachusetts Institute of Technology by Dr. H. G. Howell, of University College, Southampton, England. They are the oxides of iron, nickel and cobalt, none of whose spectra has ever been reported heretofore. If found in the sun, these will bring to 30 the number of molecules known to exist there and in all probability in all stars of a similar type. Several other molecular combinations thought most likely to be present have not yet been found, partly due to lack of laboratory data concerning them and partly because the properties of these molecules make detection exceptionally difficult.

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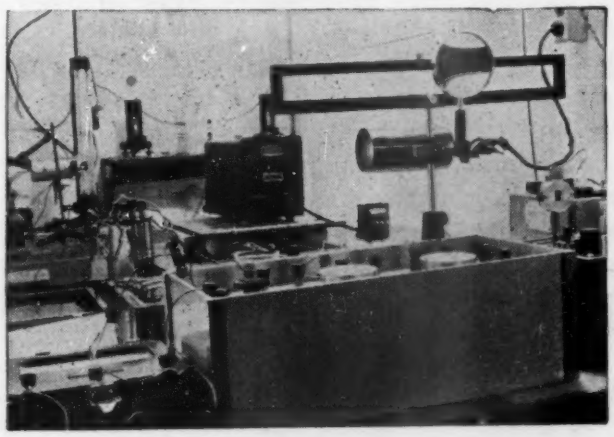

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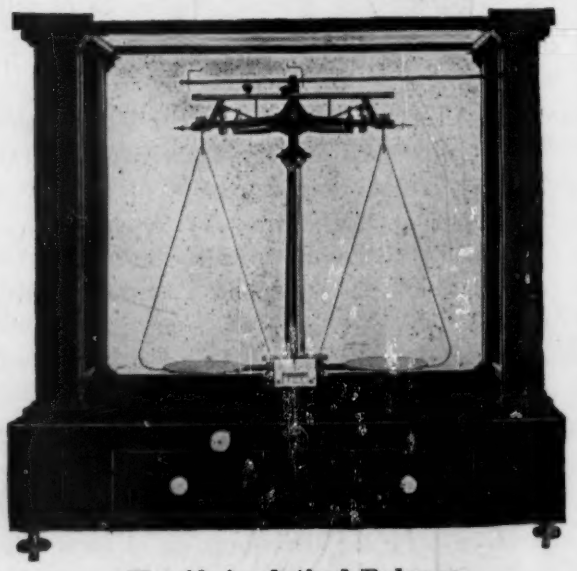

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SCIENCE NEWS

Science Service, Washington, D. C.

THE ANTARCTIC CONTINENT

WHO discovered the Antarctic continent? In spite of centuries of exploration, extending back to the visit of Dirck Gherritz in 1599, this question remains unsettled, according to a paper presented to the Pacific Science Congress, meeting at Berkeley, by Dr. Bharne Aagaard, of Stavern, Norway. The paper gave a detailed account of the various claims, among which is included Bransfield's discovery of Trinity Land, January, 1820; Palmer's discovery of Palmer Land, November, 1820; Bellingshausen's discovery of Alexander Land, January, 1821; John Biscoe's discovery of Enderby Land, February, 1831.

Another question that remains to be settled is whether the Antarctic continent once formed part of a land bridge between South America and Australia. According to a paper presented by Dr. G. G. Simpson, geologist of the American Museum of Natural History, New York, students of zoogeography have supported such a theory as a result of fossil finds along such a speculative bridge, but there is little substantial evidence to bear this theory out from a geological standpoint.

While Dr. L. M. Gould, geologist of Carleton College and geologist with Admiral Bird in the Antarctic, advised the congress that Antarctica possessed a unity of climate, life and geographic conditions which are without parallel among the continental land masses of the earth, the surface of the great continent is not all snow and ice. The inland ice does not completely submerge the rocky sub-structure. In and around Palmer Land, mountain glaciers of great variety, island ice and shelf ice are the characteristic forms in which glaciation is manifested. But little is known of the ocean margins, where the ice meets the major waters of the Pacific Ocean. It is reasonable to assume that the inland ice moves directly into the sea over wide areas.

The former lofty mountains of Antarctica have been greatly lowered through erosion and glacial action, according to a paper presented by Dr. F. Alton Wade, geologist of Miami University, Oxford, Ohio. To-day some of those mountains are represented only by their igneous cores. Dr. Wade is also of the opinion that Palmer Land and related islands comprise a continuation of the Andean mountain chain of South America, while to the east in the Australian Quadrant is the great Antarctic Horst or depressed tract of the earth's crust, which is thought to be a continuation of the East Australian Horsts.

Climatically the continent of Antarctica exerts a tremendous influence over the whole south Pacific, according to Dr. Paul A. Siple, of Clark University. While present knowledge of climatic conditions is restricted to only five or six areas where meteorological stations are maintained, Antarctica appears to be under the control of a shallow, glacial anticyclone which periodically exchanges across the southern Pacific Ocean great masses of cold polar air for warmer masses.

PAPERS BEFORE THE PACIFIC SCIENCE CONGRESS

IN certain regions earthquakes nearly always occur after a fall of atmospheric pressure, and in others after a rise in pressure, the fall being most common over the sea and the rise over the land. This is indicated by a report to the Sixth Pacific Science Congress, by Dr. R. C. Hayes, acting director of the Dominion Observatory, Wellington, New Zealand. He investigated the effects of atmospheric changes on the occurrence of 200 prominent earthquakes in the New Zealand region over the period 1931 to 1936, noting the pressure change during an interval from one to two days before the occurrence of the earthquake. The results, plotted on a map, indicated that sea earthquakes were preceded by a fall of pressure and land earthquakes by a rise. "As a fall of pressure indicates a removal of load," he said, "and a rise an increase of load, it is considered that the results give some indication of the general crustal movements at present taking place in the regions concerned."

TILTING of the ground near active volcanoes suggests the possibility of forecasting coming eruptive activities, was reported in a paper by Professor Takeshi Minakami, of the Earthquake Research Institute, Tokyo Imperial University. Tilting on a large scale preceded by about two months the explosive activity of the volcano Mount Asama, which began on April 20, 1935. The marked changes in the inclination of the ground during the active stage of the volcano clearly differ from the seasonal and other variations. Marked changes in the crater floor of Asama during eruptions were described by Professor Minakami. Two phenomena were noted, one wherein the floor rose as a whole, and the other in which explosions ejected a part of the floor from the crater in the form of volcanic bombs and ash. These two conditions differ greatly in character.

TRANSPACIFIC aviation, using coral atolls like Midway Island as "stepping stones" on the long over-water hops, would probably not yet be possible if the land had not been raised some five feet in recent times, according to Dr. Harold T. Stearns, of the U. S. Geological Survey. There is a "five-foot bench" in the Pacific, Dr. Stearns said. "So many coral atolls, as for example Midway Island, stand about five feet above sea-level that there can be little doubt that an emergence of approximately five feet has occurred in recent time." By "recent," geologists mean the epoch of time following the last Ice Age some 20,000 years ago.

THE Panama Canal may not have been the first Pacific-Atlantic water link between North and South America. Evidence presented to the Pacific Science Congress by Dr. Ralph W. Imlay, of the University of Michigan, indicates an interoceanic connection across Mexico during the Jurassic and Cretaceous periods of millions of years ago. This connection may have been through the states of Oaxaca, Guerrero and Colima, where it is described as the Balsas portal, and northern Sonora, where it is known as the Sonoran portal. Evidence of prehistoric animals indicates at least a temporary connection between the two oceans during the periods mentioned. The existence of the Balsas portal is substantiated by the occurrence of thick marine sediments

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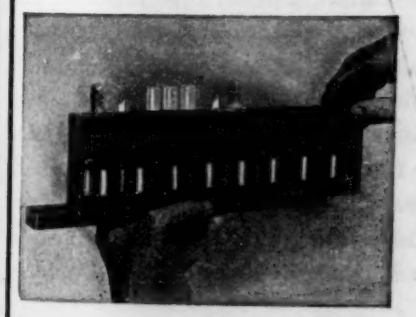

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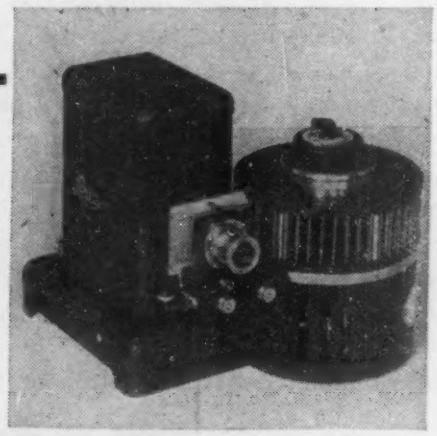

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of Upper Jurassic and Lower Cretaceous times across southern Mexico nearly to the Pacific Ocean. The existence of the Sonoran portal is less certain, but seems most likely during the later Lower Cretaceous, when an arm of the Mexican Sea extended westward across Northern Sonora and Southern Arizona at least as far as the present Patagonia mountains.

DISCOVERY of ancient human bones in an Oregon cave, and the finding of man-made articles buried beneath pumice erupted when Crater Lake formed thousands of years ago, are clews to a new chapter in American prehistory, which will force a reconsideration of views now held in regard to the early Far West, is the opinion of Dr. L. S. Cressman, of the Oregon State Museum of Anthropology, who reported the latest finds of his expeditions to the Sixth Pacific Science Congress. Dr. Cressman told of finding skeletal remains of a human being in gravel of the late Pleistocene or early Recent times of geologic reckoning, and said that the bones were apparently deposited naturally, not buried. This ancient American was found in a cave in the Northern Basin in south-central Oregon. In another cave on Summer Lake, Oregon, articles used by man have been found beneath the pumice ejected at Crater Lake's formation, an eruption which by the most conservative estimate must have taken place 3,000 to 10,000 years ago.

USE OF A CHEMICAL IN PLANT BREEDING

BIGGER and better cotton, tobacco, berries and fruits, with new chemical-created heredities, are about to result from research at the U. S. Department of Agriculture through use of a powerful and poisonous drug, colchicine. Fertile hybrids of economically important plants are being produced, successful plant crosses heretofore impossible are being achieved.

From pioneering experiments made several years ago by Dr. Albert F. Blakeslee, of the Carnegie Institution, the application of colchicine, extracted from seeds of the wild meadow saffron and used sometimes as a gout remedy, promises to give farmers better plants to grow in their fields. The drug causes rapidly growing young plants to double the number of chromosomes in their cells, juggling the heredity in such a way that the new plant created breeds true and is not sterile as are most hybrids. Chromosomes are the carriers of heredity within the cells and seeds.

Crossing of valuable Sea Island cotton of the Asiatic variety and American upland cotton is being undertaken by Dr. J. O. Beasley, of the Bureau of Plant Industry, working in North Carolina. For the first generation this cotton cross produces a form which gives the typical long fibers of Sea Island cotton with the early maturity of the American upland cotton. This hybrid, however, while fertile, goes to pieces after the first generation cross and loses its desirable qualities.

The drug colchicine, by doubling the number of chromosomes in the cells of the plant, allows the production of a fertile hybrid of the cotton that will breed true. To get a true-breeding strain depends on a freak of nature found commonly in Sea Island and at times in upland cotton. It is a twin embryo. Usually one of the embryos produces a shoot with only half the number of chromosomes in one set instead of the regular two sets required for fertility. By doubling the chromosome number of this shoot with colchicine, it is hoped to get a pure-line cotton with two sets of identical chromosomes which should breed true.

Dr. H. H. Smith, at the Arlington, Va., Experimental Farm of the U. S. Department of Agriculture, has obtained similar results with hybrid tobacco which, in some forms, has great value as an insecticide. This is especially true of wild tobacco of which one type contains nor-nicotine, an alkaloid related to nicotine but much more potent in killing insects.

Drs. Haig Dermen and G. M. Darrow, working at Beltsville, Md., have tried colchicine on berries and fruit trees and hope to produce a permanently reproducing cross between Loganberries and ordinary blackberries. Crossing of red raspberries with other berries is expected to yield a variety that will grow in warm southern climates. The work with peaches has only just been done. What its results will be can not yet be determined because it will take a year or two to obtain fruit from the trees.

THE DEVELOPMENT OF ALASKA

By LEONARD H. ENGEL

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FORMATION of one or more private development corporations like the world-famous "Hudson's Bay Company" to people Alaska with American citizens and refugees and turn it into a prosperous "Scandinavia of the West" is to be suggested in a Department of Interior report slated for early publication.

A population of five million or more, the report will maintain, can easily be supported in the territory, which, one fifth the size of the United States, now has less than 60,000 inhabitants, including Eskimos and Indians.

It is urged that opening up the territory to large-scale colonization would provide a market for American capital goods equivalent to a heavy increase in the U. S. foreign market. At least half the settlers will be American citizens. Among the others would be carefully selected refugees from foreign lands. The plan would thus also be an American answer to European persecutions of minorities.

Private development corporations like the Hudson's Bay Company, which settled Canada, and the Plymouth Company, which sent the Pilgrims to the then unknown wilderness of the Atlantic coast, have been the most successful type of colonizing agency. One or more of them is therefore recommended for Alaska. Their dividends would be limited and their activities carefully delineated by law. Financing would be entirely private.

Providing that the plan secures support of Alaskans and others concerned, necessary legislation is expected to be introduced into the next session of Congress. Present immigration laws would be modified so as to permit aliens selected by the companies to settle in Alaska. Immigration quotas of the United States would not be altered. If the Alaskan settlers wished to become citizens or to enter the United States, they would have to apply for immigration quota numbers like other aliens. At least one large refugee-aid group is definitely interested.

Sponsors of the plan favor the establishment of more than one corporation. "Competition will be good for them," one declared. Besides, where diverse national and cultural groups are involved, they are likely to work better if each is allowed to work out its own problems instead of all being forced together into one company.

The society the colonists would build would be based primarily on manufactures exploiting Alaskan resources. The industries either would not duplicate those of the United States at all or would produce goods of a type now largely imported. Among the industries are paper manufacturing, lumbering, salting and pickling herring, woodworking, production of minerals such as tin, manganese and chrome ores, fur farming and leather working. Agriculture can supply a substantial part of the food supply of the new natives, although by no means all of it.

A National Resources Committee report quoted by sponsors of the plan indicates that Alaska is potentially richer than Sweden and Finland together. With an area two thirds larger and far better endowed by nature than the two Scandinavian countries, it now supports a population 1/165th as large. Half the population is Eskimo and Indian.

SLIPPING OF METAL CRYSTALS

SLIPPING layers of material, such as produce ranges of high mountains in nature, are being used on a microscopic scale here to show how metals behave under severe pressures. In the metallic world, the slippage occurs along tiny crystal planes of the metal.

A research movie just completed at the research laboratories of the Westinghouse Electric and Manufacturing Company here under the direction of Dr. A. Nadai, consulting mechanical engineer, opens with a two-foot strip of steel, white and smooth. As a tremendous pull comes into play, the test specimen begins to elongate like a huge rubber band. While this stretch is within the elastic limit of the steel all goes well. But soon there appear the "villains"; first a tiny black line that runs diagonally across the specimen. Soon another, and another, each time about half an inch apart at an angle of approximately 45 degrees with the direction of pull. By the end of the film the whole test specimen is criss-crossed with a maze of these lines. These lines are the distinguishable marks of slip planes of the crystals of the metal.

Each of these microscopic crystals, containing about 27,000,000,000,000 (27 trillion) individual iron atoms will —if pulled strongly enough—start slipping and attempt to relieve the pressure in this way. Paradoxically the slipping does not occur uniformly throughout the steel bar, but in localized areas and the deformed part is stronger than the unaffected parts. Slip lines must be eliminated in the rolling of steel, for they might make their appearance through a paint finish on an automobile.

The stretching of a steel bar, says Dr. Nadai, parallels on a laboratory scale the large-scale effects of stresses in mountain building. An outstanding example is the Jura chain of mountains in Switzerland, which has been pushed together into a band some eighty miles north of the Alps.

ITEMS

DR. ROBERT A. STEINBERG, of the U. S. Department of Agriculture, has discovered that traces of gallium are necessary for growth and reproduction of one of the common mold fungi, and he suggests that it may be proved necessary for other planets as well. Very little gallium was found sufficient for the needs of the fungus—10 to 30 parts per billion of water. No other element could be successfully substituted. Although gallium is one of the rarer elements, what there is of it is widely distributed in nature.

SHOCKING a patient by electrical means as a promising treatment for failing circulation of the blood is reported in the *Journal* of the American Medical Association. Many a surgeon has watched a patient sinking into traumatic shock and many a physician has observed a patient exhausted by illness, the editorial explains, only to find there is some element in the mechanics of blood circulation beyond medicine's control. Now Drs. G. G. Ornstein, Sidney Licht and Myron Herman, of Sea View Hospital, New York City, have reported a method of raising venous pressure in a case of shock, particularly applicable to circulation failure under spinal anesthesia. Towels soaked in salt solution are wrapped around the patient's body and legs. Electrodes are connected and an induced electric current is applied. This causes a distinct rise in pressure of blood in the veins. The original suggestion that low blood pressure arises from a failure in the tonus of the body's muscles which lowered the gentle pressure sending blood from the tissues into the veins and back to the heart came from Professor Yandell Henderson and his group of investigators at Yale University.

THE "mummy" of a duckbill dinosaur that had old-age trouble with its back—ninety-five million years ago—is being studied at the Smithsonian Institution. The big creature had a stiff back due to ossified tendons, or the hardening of some muscles into bone, is the belated diagnosis of Charles W. Gilmore, Smithsonian paleontologist. Old turkeys sometimes have the same condition. "Mummy" dinosaurs, so-called because the print of the rough hide is preserved over the bones, are extremely rare, only about ten being known. The Smithsonian's specimen, from the dinosaur quarry in Alberta, Canada, shows the skin in fairly well distributed patches over the body. Mr. Gilmore infers that dinosaur hide would make excellent leather, if there were any left.

THE use of safety plate glass on all the windows of motor vehicles will help to prevent many cases of "car sickness" and the headaches accompanying eye fatigue, according to Dr. A. H. Ryan, Chicago physician. Eye fatigue, he finds, is 62 per cent. greater when looking through safety sheet glass than it is when looking through safety plate glass. The tiny, almost imperceptible waviness of sheet glass, in contrast to the polished smooth surface of plate glass, distorts the vision, in laboratory as well as driving tests. The constant, automatic adjustment of the eye to this distortion causes fatigue. Most cars now have safety plate glass in the windshield, but the less smooth glass is often used in other windows. The tests were made for General Motors' Fisher Body division and the Libbey-Owens-Ford Glass Company.

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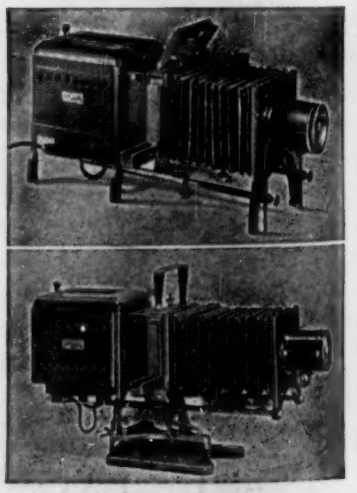

Above, Model B Balopticon for lantern slide projection. Below, Model BDT, the same as model B but with a convenient tilting base.

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SCIENCE NEWS

Science Service, Washington, D. C.

ISOTOPES, THE NEUTRINO AND URANIUM SPLITTING

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A NEW way of separating isotopes quickly and effectively is suggested by Professor J. W. Beams and Dr. C. Skarstrom, of the University of Virginia, in the current issue of *Physical Review*. The new method would combine the whirling properties of high-speed centrifuges with the chemical fractionating column method employed by Professor Harold C. Urey, of Columbia University. Isotopes are the forms of chemical elements which have chemical properties so similar that ordinary chemical methods will not separate them. Yet they have slightly different atomic weights. Separating isotopes is one of the major tasks of physicists these days, for isotopes can be employed as "tracers" in studying the physiological happenings of the human and animal body and have already contributed much to knowledge of hitherto obscure body processes. To operate the new method would require a huge centrifuge, weighing tons, for the columns used at Columbia by Professor Urey are two stories high. An apparatus to whirl them around in a super-centrifuge would be very large.

In the same issue, Drs. H. R. Crane and J. Halpern, of the University of Michigan, describe their latest search for the elusive and never-found atomic particle, the neutrino, which is believed to have the mass of an electron, without electrical charge. By bombarding chlorine with deuteron particles from the huge Michigan cyclotron, the scientists have made it emit electrons, or beta rays. Studying the pictures of these beta rays in a Wilson cloud chamber has shown that the ordinary, every-day laws of classical momentum are not conserved unless one assumes that another particle (the neutrino) is liberated in the process. Because of the neutrino's neutral character actual pictures of its tracks have not been obtained, and probably they will never be found. But there are relationships showing definite directions in space in which the change of momentum occurs. This is interpreted as the line of direction of the neutrino.

The new attacks on the secrets of uranium splitting—the potential source of atomic power if scientists can ever find out how to create it efficiently and then control it after they have it—are also described. Professor Enrico Fermi and Drs. H. L. Anderson and Leo Szilard, of Columbia University, report that by bombarding uranium with slow neutrons they obtain a 20 per cent. gain in the number of neutrons emitted. This is evidence—slight but probably real—that the splitting of uranium, with its enormous release of atomic power, is probably accompanied by a chain reaction that creates more neutrons to produce more uranium fissions, and so on. The whole question of atomic power is still in the balance, for the experiments have yet to give a conclusive answer. The Columbia results are more conservative than reports which have come from France. Another new finding is the study by Drs. J. C. Mouzon and R. D. Park, of Duke University, on the delayed emission of piercing gamma rays from uranium excited by neutrons. Taking Wilson cloud chamber photographs of the bombardment out of a great number, one highly interesting picture was obtained. This may be the first evidence yet found of a multiple fission of uranium. Previously it has been shown that uranium can be split into two parts by neutron bombardment. The new pictures may reveal a splitting into three or more different products instead of into the usual two. More work will be needed to clear up this important point.

ADVANCES IN THE MEDICAL SCIENCES

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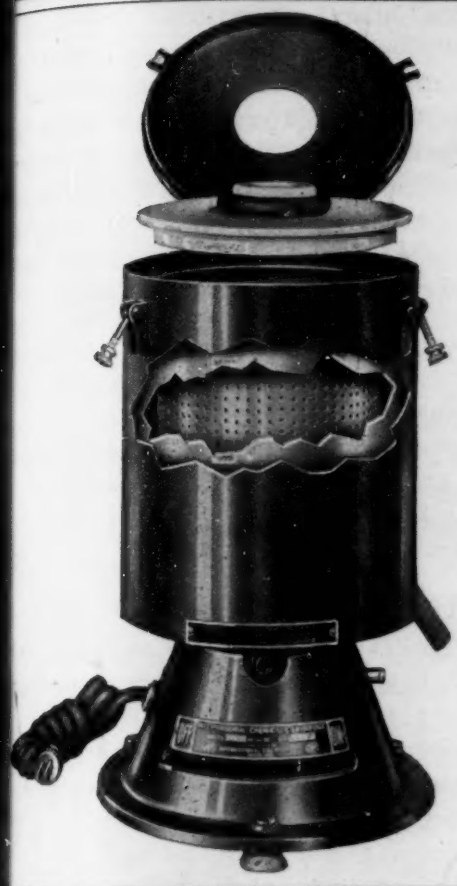
WARNING that the drug, salfapyridine, used successfully in treating pneumonia, can damage dangerously the white blood cells is contained in a report in the current issue of the *Journal* of the American Medical Association by Drs. Nathan Rosenthal and Peter Vogel, of New York City. They found granulocytopenia in three children treated with the drug. Sulfanilamide also causes the trouble and cases caused by sulfapyridine have previously been reported in adults. Careful tests of blood for possible danger signs are advised when the drug is being used.

A unique case of a Japanese beetle feeding on the ear drum of a man is reported by Dr. Max Kimbrig, of Huntington, N. Y. The legs or biting equipment of the beetle were stuck fast in the ear drum when Dr. Kimbrig removed it, and a large part of the drum was perforated. Dr. Kimbrig writes: "Since the Japanese beetle is herbivorous, it is difficult to understand his appetite for human ear drums. I have been unable to find in the literature any report of the destruction of an ear drum by a beetle that lives on plants."

The recent report of Drs. Fritz Kogl and Hanni Erxleben, of Holland, that they had found unnatural forms of amino acids in malignant tissues, is given notice in the *Journal* of the American Medical Association, and editorial stating that if confirmed by other workers and if all types of cancer tissues contain them "a new and fertile field for study into the nature of cancer will be opened."

Stating that vitamin F has not been established as a vitamin although it has been commercialized by firms marketing cosmetics, a committee of the American Medical Association has endorsed the elimination of the term by the American Society of Biological Chemists and the American Institute of Nutrition. Reduction of the number of vitamin A and D preparations is recommended. Even since the committee on vitamins made its most recent report, the *Journal* observes that "vitamin B_6 has been synthesized, the chemistry of vitamin K has been clarified to a considerable extent, and evidence has accumulated concerning the significance of these factors and of riboflavin in human nutrition."



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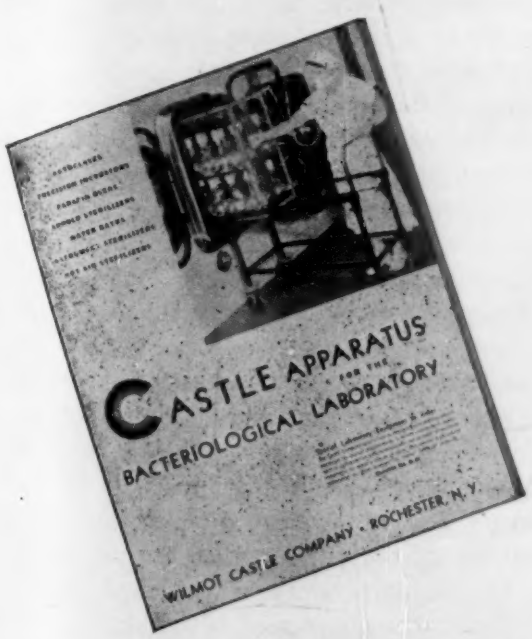

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THE CONGRESS OF AMERICANISTS IN MEXICO CITY

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NEWS of prehistoric America—its buildings concealed beneath buildings; its fortune-telling mothers; its first, all-but-wild corn crops—the latest scientific discoveries on these and several hundred more angles of ancient Americans are being reported in a barrage of papers read before the International Congress of Americanists in Mexico City.

Discovery of a temple which has been concealed for hundreds of years beneath the famous lofty Mayan temple "El Castillo," at Chichen Itza, was reported by José A. Erosa Peniche. The stairway, façade and chambers of this ancient building, which Mayan Indian architects covered over to raise a higher, more impressive temple on the lofty pyramid base, were found by tunneling beneath the present structure, to avoid damaging it. Other archeologists told of probing other Indian monumental buildings in similar fashion, as Mexico burrows deeper beneath the visible present.

Mayan Indians, greatest scholars of ancient America, knew exactly when to introduce inter-calendar days necessary to keep their year in step with the sun, according to Erwin P. Dieselforff, of Copan, Guatemala. He states that eclipses of the sun were of major interest to these ancient American astronomers, explaining the Mayan method of forecasting when eclipses would occur.

Mayan Indian mothers consulted astrologers in their anxiety to know what good fortune or bad might be the destiny of their babies. Four of the lists of days and their omens, found in the books of Chilam Balam, have been studied by Alfredo Barrera Vázquez, of the National Museum at Mexico City, and he has concluded that the custom of guarding babies' fortunes by giving them calendar names up to a certain age was used by Mayan mothers of Yucatan, as well as by those in Indian nations of Mexico proper.

Tackling the much-argued question of when the first corn was raised by the first New World farmers, Pablo Martínez del Rio advanced the theory that agriculture may have had a more rapid rise in America than in the Old World. Differences in methods of seed selection and cultivation, he believes, speeded up results for Indian farmers, so that it is not necessary to conclude, as some botanists have, that American Indians must have started on their road to higher civilization an extraordinarily long time back.

The newest excavations at Monte Alban, Mexico, scene of the discovery of a Treasure Tomb a few years ago, have demonstrated who built the mountain-top city. Indians of the same cultural heritage built both Monte Alban and the remarkable valley city of Milta not far away. Architectural ideas are the same in both cities, according to Dr. Alfonso Caso, director of Monte Alban excavations. Three stages of Monte Alban's ancient history have been traced, and can be linked in time with Mexico's cultural stages of the Archaic, older than the Christian era, then Teotihuacan or Toltec, and Aztec.

The effort to find out what was going on in different parts of Middle America, during its great Indian era, have led archeologists to explore pit tombs near Guatemala City. Dr. A. V. Kidder, of the Carnegie Institution of Washington, reported finding that these tomb-builders were living while Monte Alban in southern Mexico was in its middle stage, and the great Toltec Indian civilization in central Mexico was nearing its decline. Pottery from the Guatemalan tombs provides the key for linking the tomb builders with other tropical American cultures and drawing Central America more closely into the picture.

Success in finding one of the missing stone statues from Tiahuanaco, Bolivia, which a French traveler carried off to Europe a century ago, was reported by Henri Lehmann. Modern investigators have never seen these statues, he said, but one of them, a statue combining human and animal features, has been found and placed at the Gate of the Sun in Tiahuanaco.

CORAL REEFS IN THE PACIFIC

CORAL reefs 1,200 miles long, extending as far as 150 miles from the coast line and sheltering huge clams four feet long and weighing more than a hundred pounds, were described by Professor C. M. Yonge, of the University of Bristol, England, speaking before the Sixth Pacific Science Congress meeting at Palo Alto on August 9.

"No ocean contains so rich a growth of coral reefs as does the Pacific," he told the congress. "Fringing reefs bound the land within the tropics especially along its western shores and atolls are scattered far and wide throughout the South Seas. But the greatest coral formation of all is the Great Barrier Reef of Australia. This immense series of reefs extends along the northeastern shores of Australia from the tropic of Capricorn in the south almost to the shores of New Guinea in the north, for a total distance of more than 1,200 miles. It is made up of thousands of individual reefs which extend in places as far as 150 miles from the coast."

The biology of the corals which form these reefs was examined by the Great Barrier Reef Expedition, which worked for more than a year in 1928–29 on a small coral island midway between the outer reef and the mainland.

"Corals are essentially sea anemones which have acquired the power of forming massive limey skeletons," Professor Yonge explained. Many grow to a great size, forming colonies which may be rounded and massive, branching and tree-like, or flat encrusting sheets, according to the region where they grow. Corals of the first type are found especially on the exposed outer surface of reefs, those of the second type in sheltered water in the lee of reefs, and of the third type on the summits of reefs where the surf sweeps over when the tide is out.

"Corals are all carnivorous. They feed, usually by means of delicate tentacles armed with batteries of stinging cells, on the minute animals which drift in the surface waters. Most corals only expand by night when alone; this animal life is abundant near the surface.

"Within their tissues are contained countless numbers of minute plants called zooxanthellae. It had been thought that these contribute to the food of corals, but this was found not to be the case. They do automatically remove

the waste products formed by the corals and in this way probably aid in the remarkable rate of growth possessed by corals. These can frequently double the bulk of their skeletons in six to twelve months, and it is this rapid growth which has made possible the formation of reefs many miles in length, of great depth and thickness, which are capable not only of resisting the destructive action of the Pacific breakers, but of actually growing out against the full fury of the sea.

"Corals are among the most successful and most highly specialized of all marine animals and different kinds of corals are adapted for life in all regions of the reefs. On and in the reefs live an immense and diverse assemblage of animals and plants of all kinds and many, notably the fish, of great beauty. The most spectacular of all are the giant clams which may attain a length of more than four feet and which weigh more than a hundred-weight. These gigantic 'cockles' are the largest bivalve shellfish ever evolved."

NEGROES AND INDIANS IN COLOMBIA

A RACIAL struggle in America fought, not with guns, but in biological terms of the survival of the fittest, is being won in northern South America by African Negroes. Losers in the struggle, Choco Indians of the Pacific coast of Colombia, are apparently doomed to extinction, according to the report of Dr. Robert Cushman Murphy, of the American Museum of Natural History, to the *Geographical Review*, the journal of the American Geographical Society. In one section of Choco country there is now one Indian to every 160 Negroes.

Calling the Negro "the fittest heir of the Choco," Dr. Murphy states: "Transplanted from Africa, the Negro has become, as regards survival, a 'native' superior to his predecessor, even over the obstacle of a greatly inferior sanitary code."

Dr. Murphy points out that the African is more resistant to white man's diseases than the Indian. Also, the African's traditional "million years" of selective evolution in the hot and humid Congo may help to explain why the Negro in Colombia's tropics thrives, while the Choco Indian with a mere 10,000 years of tropical heritage, at the most, is retreating farther into the interior and dwindling in numbers.

Psychological and psychic weapons of the struggle give the African another advantage. The Negro considers himself a Colombian, and the Indian a savage. This attitude stems from the Negro's association with white men, and his adoption of the Spaniard's language and attitudes. Magic power of the Negroes is held in universal awe by the Indians, who fear evil eye power that supposedly can kill fish by a glance or cause children to fall ill. Indians, on their side, arouse fear in the Negroes by their lore of poisons, and their handling and "planting" of deadly snakes to do harm. But the psychic advantage, Dr. Murphy concludes, is on the Negro's side. One of the most horrible demons in Choco Indian lore has taken on the guise of a Negro.

ITEMS

THE nation's infantile paralysis chart, closely watched by the U. S. Public Health Service, shows a rise for the week ending on August 5, when 208 new cases were reported. This figure, however, is well below the median of 250 cases, which might be expected in the height of summer for this disease. South Carolina reported 17 cases, California 57, Michigan 49, New York 13. Early September will see the disease start a downward curve, according to twenty years' observation of its summer course.

THAT the entire diameter of the sun is now covered with a band of sun-spots is disclosed by new photographs taken at the U. S. Naval Observatory. The band is about evenly distributed north and south of the sun's equator and consists of eight groups with two sun-spots to each group.

THE Smithsonian Institution has acquired an implement that had more to do with the winning of the West even than Daniel Boone's famous long rifle. It is the first steel plow forged by John Deere at Grand Detour, Ill., in 1837. Made of an old sawmill saw because other suitable steel was lacking, it was able to shear through the tough roots of the prairie grasses that balked the relatively feeble Eastern-type plows which the pioneers had brought with them. The reputation of blacksmith John Deere's steel plows spread, and presently he and his partner gave up general blacksmithing altogether and became specialists in plow manufacturing. In 1846 they turned out 1,000 sod-breaking plows—a mass-production figure, for those days.

THERE'S no metal from heaven in evidence inside the huge meteor crater in Arizona. All metal must have spattered outside when the meteorite crashed to earth, according to Samuel G. Gordon, Philadelphia Academy of Natural Sciences geologist, who has just returned from an expedition to study America's biggest "shell-hole." About 15 tons of fragments of the meteor, ranging from a few ounces in size to half a ton, have been found in a radius of several miles. Mr. Gordon found that the crater itself, several hundred feet deep, is filled with about 80 feet of sediment. Shells of existing types of water creatures in the sediment indicate that the meteor struck thousands of years ago, when the region was less dry. Mr. Gordon will supervise the making of a scale model of the crater for the exhibition of the academy.

A SINGLE determination of high lead content of blood or urine can not be considered a diagnostic sign of lead poisoning although it may be indication of it, according to Professor R. A. Sawyer, Dr. R. W. Waggoner and A. A. Erickson, of the University of Michigan, in a paper read before the conference on spectroscopy at the Massachusetts Institute of Technology. They reported spectroscopic analysis of about 1,000 samples, with every one showing measurable lead and typical random distribution. Seven apparently normal persons showed high content, while two definitely known cases of plumbism showed only average content. The findings were further complicated by day-to-day variations over wide ranges. There is, however, some correlation between average lead content and occupational exposure. The concentration in samples from painters, for example, was almost double that of white collar workers.

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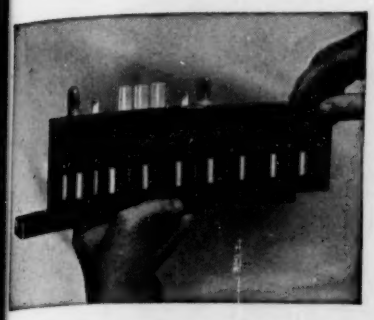

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SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS PRESENTED BEFORE THE GEOLOGICAL SOCIETY OF AMERICA

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GREAT mud-laden "waterfalls" deep down in the ocean are pouring the sediment of California rivers into ocean bottom basins, Professor F. P. Shepard, of the University of Illinois, told the recent meeting at Berkeley of the Geological Society of America. About 150 miles west of San Diego and far under water is a submerged 10,000-foot mountain whose slopes have been found to be absolutely bare of the sediments which one might expect to find. Bare, too, are submarine canyons off the California coast out to depths of 5,000 feet. This raises the point of what happens to the tons upon tons of sediments borne to sea by California rivers. According to Professor Shepard: "A large amount of the sand poured in by rivers is brought back by the waves which distribute it on the beaches while the bottom currents carry the mud out over the (continental) sheaf into the deeper troughs and basins outside. The submarine canyons are kept clear of sediment largely by means of the great mud flows although currents are partly responsible."

The wide-spread sage-brush of the Great Basin area of the far west probably got its start because the Sierra Nevada-Cascade mountain range rose up and blocked off moisture-bringing winds from the Pacific, according to Dr. Daniel I. Axelrod, of the University of California. By a study of fossil plants he has been able to learn what plant life was like in the Late Pliocene era about 1,000,000 years ago. About this time, Dr. Axelrod reported, a great change in the weather occurred in the West. On the northwest coast, over what is now Oregon and Washington, rainfall dropped from 25 inches yearly to the 13 inches it is to-day. And in southeastern California it fell from 12 inches yearly to the three inches of rain which now falls on the land. The slow rise of the Sierra Nevada-Cascade Mountains probably was the basic cause of this. As they rose these ranges gradually intercepted more and more of the rain-bearing Pacific winds. Plants able to live in the increasingly drier climate prevailed. Sage-brush became king. A few of the Pliocene trees managed to survive—the pinyon pine, juniper, cottonwood and antelope brush—in Nevada. But generally they have continued to exist only in the mountains and on a few favorable sites bordering deserts.

Intensive studies of records of many California earthquakes have shown the "keel" of the southern Sierra Nevada mountain range, is stated in a paper by Professor Perry Byerly, of the University of California. One theory of geology, Professor Byerly recalled, is that mountain ranges are masses of heavy rock "floating" in weak rock not unlike ships floating on the ocean. The new discoveries indicate that the mountain ranges have a keel. Actually the keel seems to be a root of granitic rock penetrating much deeper into the weak rock under the range than does the range itself. Bottom of the Sierra Nevada range a pears to be at a depth of 20 miles. The keel goes dow still farther.

Fifty miles below the surface of the earth the ordinar crystalline structure of rocks gives way to a glassy co dition, according to Professors B. Gutenberg and C. Richter, of California Institute of Technology. Studi of the records of earthquake vibrations have revealed th new knowledge. Highly important to geology is the di covery for it has long been suggested that the earth co sists of many concentric shells of different materi packed, one around another, like the layers in an onio "From all the evidence," Professor Gutenberg said, " may be calculated that certain physical properties cha at a depth of about 50 miles. From other clues we co clude that this depth is probably that at which the crysta line structure of the rocks is reflected by a glassy co dition."

PAPERS PRESENTED BEFORE THE AMERICAN PHARMACEUTICAL ASSOCIATION

A METHOD for detecting the presence of carbon m oxide in very minute quantities, as an impurity in oxyg intended for human inhalation, was described before t meeting in Atlanta of the American Pharmaceutical As ciation by Drs. Frederick K. Bell and John C. Krantz, J of the School of Medicine of the University of Maryla Oxygen is supplied compressed in cylinders for use pneumonia patients and other critically sick perso aviators at high altitudes, firemen, mine rescue worke etc. The presence of even small quantities of poi ous carbon monoxide would of course be extremely dang ous, particularly in hospital use. The test is made wit reagent consisting of a dilute mixture of blood and py tannic acid. This is gray-brown in the presence of contaminated oxygen, but turns pinkish when it co into contact with carbon monoxide in mixtures even dilute as five parts per million.

EXPERIMENTS with an old-fashioned remedy which long been discarded as of no particular value showe to be capable of relaxing cramps in certain of the b organs was brought out in a report by Dean A. Rich Bliss, of the School of Pharmacy of Howard College, B mingham, Ala. The drug is *Potentilla anserina*. grows as a common weed everywhere, but Dr. Bliss ha send to Germany to get it in prepared drug form. Exp ments on animals brought out its almost-forgotten va

THE value of sodium hypochlorite solutions for trea athlete's foot was emphasized at the meeting of the A ican Pharmaceutical Association, by Drs. J. B. Vaug and H. George DeKay, who reported the results of exp ments carried on at Purdue University. Solutions of chemical as weak as one tenth of one per cent. in avail chlorine were found capable of inhibiting the growth the fungus that causes athlete's foot, when permitted 20 seconds' contact.

PECTIN, the stuff that makes jelly "jell," is the base a new type of medicated paste that is having great ccess in the healing of bed sores and stubborn ulcers. r. Bernard Fantus and H. A. Dyniewicz, of the Univer- y of Illinois Medical College, stated that advantages imed for the new paste are that it gives the healing ssue a more nearly natural medium in which to grow, that needs to be changed less often than the dressings now ed, and that its cost is much lower. To the base, which y be either pectin or gum tragacanth, Dr. Fantus and r. Dyniewicz add Ringer's solution, which is a synthetic pproximation of the inorganic parts of the blood fluid. he paste is applied thickly, covered with a piece of water- roof transparent cellulose sheeting, and the dressing stened down with adhesive tape. Different medicaments y be added for specific types of ulcers: sulfanilamide r streptococci, ethyl aminobenzoate for painful ulcers, rea when necrotic tissue is present, etc.

"MELANOID," A SKIN PIGMENT

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"MELANOID," a hitherto unknown kind of coloring atter, has been discovered in skins of all peoples, from le blonds to Negroes, through the use of a new optical strument, the recording spectrophotometer. This dis- very, made in the course of researches by Dr. Edward Edwards, of the Harvard Medical School, and Dr. S. imby Duntley, of the Massachusetts Institute of Tech- logy, raises the number of known skin pigments to five. The researches of Drs. Edwards and Duntley constitute e first precise study ever made of the complex factors derlying variations in the color of human skin. The vestigation, which may have significant bearing on many portant and puzzling medical problems, is in progress the Massachusetts Institute of Technology. Already e results are enabling doctors to diagnose anemia far re effectively than has been heretofore possible and to tch minutely the progress of attempts to stem its wast- g tide. The experiments may also afford medicine a luable diagnostic tool and method of observing treat- nt in circulatory disorders and various vascular and in diseases, and may also contribute to studies of dis- rbances of the endocrine, or ductless, glands which pro- ce those all-important chemical messengers of the body, e hormones. Disorders of these glands underlie a wide riety of far-reaching bodily ills.

Key instrument in the research is the recording spectro- otometer developed by Professor Arthur C. Hardy. ith its aid it has been possible to make speedy and pre- e analyses of skin colors which are as objective as the mperature readings of a thermometer. Thus not only es it improve on previous methods, which have relied rgely on the erratic human eye, but it also automatically alyzes the color of the skin by examining its capacity to flect light at each separate wave-length, a task impos- le for the human eye.

Melanoid is a diffuse form of melanin, long known as kin pigment. Melanin is characteristic of brunets, and minates the complexions of Negroes and other black ces. A third pigment, carotene, which is responsible r the hue of carrots, has never previously been recog- nized as a color component of the human skin. The other two pigments involved in skin color, and the most important in producing its pinkish flesh tint, are the two forms of hemoglobin found in the blood, oxy-hemoglobin and reduced or oxygen-free hemoglobin. The turbidity of the deeper layers of the skin furnishes an added effect of light-scattering, which adds a bluish component to the general skin color. Without this scattering, a phenomenon probably best known for giving the sky its blue, the normal skin would appear much like a piece of Cellophane-wrapped, raw beefsteak.

All peoples have these five color pigments. Variations in skin color, from Nordic to Negro, are due entirely to the proportions in which they are blended. Melanin and melanoid are particularly important, for their abundance results in a dark skin and a lack of them gives a light skin. The bodily distribution of these pigments is identical for all races, but the amount is purely a matter of constitutional and racial factors. White men have the least melanin, they found, and it steadily increases in the Japanese, Hindu, Mulatto and Negro, in that order.

The research is reported in the current issue of *The American Journal of Anatomy.*

SKIN RASH FROM SYNTHETIC INSECTICIDE

DISCOVERY that a new synthetic insecticide was causing a skin rash or dermatitis among the workers who handled it in the chemical manufacturing plant where it was being made for the market has resulted in suspension of operations for the time being. Drs. Louis Schwartz and Leon H. Warren, of the U. S. Public Health Service, who investigated the case, recommend that all insect sprays be given a cautionary label, for any of them is capable of injuring sensitive persons, with damage suits against manufacturers as a possible consequence.

The new chemical is known as alpha naphthyl isothiocyanate. Although not so poisonous to flies as pyrethrum and derris, vegetable poisons now commonly used in sprays, it is so much cheaper that it was intended to mix it with these ingredients in commercial liquid insecticides. Then it was discovered that some of the chemical workers who came into contact with it were getting a troublesome rash on their skins. Investigation by the U. S. Public Health Service followed.

It is not thought at present that manufacture of the chemical must be stopped permanently, especially since the ingredients already used in insect sprays are known to be poisonous to some persons. If manufacture is resumed, the compound is to be handled only in a closed system of containers, filters and pipes, by workers well protected with inhalers, goggles and special clothing.

Finally, Drs. Schwartz and Warren make the following recommendations for all spray insecticides, including those now on the market: "The directions on the cans should be worded in such a manner as to impress on the consumer the fact that the contents are toxic and irritating to the skin unless they are used according to directions. This would place the emphasis on their toxicity and tend to make people more careful in using them. Indeed, placing poison labels on all insecticides would better safeguard

not only the health of the consumer but also the financial interests of the manufacturer by helping to protect him against lawsuits. The directions for use should state that in spraying these substances protective clothing should be worn, the face and other portions of the skin should be exposed as little as possible to their action, and that the containers should be kept away from articles of food and out of the reach of children.''

CORN AND TEOSINTE

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CORN is not descended from the heavy-stalked Mexican grass called teosinte; more likely teosinte is descended from corn. Evidence pointing strongly in this direction was presented at the opening session of the seventh International Congress of Genetics, by Professor P. C. Mangelsdorf, of the Texas Agricultural Experiment Station.

It has long been contended that corn was derived, in some long-forgotten age, from teosinte, largely because teosinte grows abundantly in the wild state in Mexico and Central America, where corn, whose wild ancestor has never been found, was the staff of life of the great Indian civilizations.

Professor Mangelsdorf, suspecting that teosinte, not corn, might be the descendant, tried making hybrids of corn with a related wild grass, Tripsacum. He obtained intermediate forms, that suggested teosinte in some of their properties. A critical re-examination of teosinte disclosed the interesting fact that every character of teosinte is found in either corn or Tripsacum, or is intermediate between the two. Not only is this the case, but analysis of the heredity-bearing chromosomes within the cells of his hybrid plants showed that the germ-plasms of corn and Tripsacum are capable of the intimate mixtures and interchanges that are required for the origination of stable hybrid forms.

As more probable ancestor to corn, Professor Mangelsdorf pointed to pod corn, a strange type with each kernel covered in an individual husk, now grown only as a curiosity. He suggested that a wild pod corn may still be growing, somewhere in the lowlands ''back of the Andes,'' in whose valley and plateau lands corn was first extensively used by highly civilized Indian nations.

ITEMS

THE home of the world's weather—the zone of atmosphere just above the surface of the earth where warm and cold air masses intermingle to produce rain, clouds and hot and cool spells—has now been shown to act as a mirror for radio waves. Professor R. C. Colwell and A. W. Friend, of West Virginia University, describe their studies of radio reflections at the sharp boundaries between hot and cold air layers in *Nature*. The radio mirrors are not at extreme heights of scores of miles in the ionosphere at the place where radio reflections are commonly known to occur. Rather they appear to come in the troposphere at altitudes no greater than a mile and a half or about 9,000 feet. Some seem to occur as low as 6,000 feet. Three years ago such reflections were suggested from radio measurements alone. Now they give, side by side, a comparison of the radio reflections and the existing height of the layers of temperature inversion in the troposphere. Ai plane flights directly over the experimental radio tran mitter used in the tests during the times of the experime furnished accurate, conclusive proof of the equal heigh of the sharp temperature boundaries and the place of radi reflection.

A SUCCESSFUL and cheap method for manufacturin colloidal fuel from coal is being sought, through an indu trial research fellowship at Kansas State College. A though colloidal fuel is not now being used industriall anywhere in the United States, investigations to date ha offered promise of finding a technique which would b cheap enough to make it an important possibility for rai road fuel and for use in power plants where either fuel o or pulverized coal is now burned. Dean R. A. Seaton, the Division of Engineering of the Kansas State Colleg explained that a satisfactory colloidal fuel would help utilize effectively the petroleum supplies of the Unit States.

EUROPEAN sleeping sickness, a disease that has appeare during post-war years, may be growing weaker, or mankin may be growing stronger against it. These alternati hypotheses for its declining incidence are offered by th Matheson Commission which has been investigating th disease, under the chairmanship of Dean Willard C. Ra pleye, of the School of Medicine of Columbia Universit Epidemic encephalitis, as the disease is technically know has been attacked with various medical weapons. Newe is benzedrine sulfate, the so-called ''pep pills'' exam-cramming students. It is given either alone or combination with atropine. The combination treatme is said to yield best results. However, a real cure see still as remote as it did ten years ago.

A NEW type of organic resin material which can b made into artificial silk fibers has been patented at th U. S. Patent Office by the Canadian inventors, George Morrison and Aubrey F. Price, of the Province of Queb The new resins are of the vinyl-acetyl type. Fourte different ways of preparing them are described in th patent, which has been assigned to Shawinigan Chemica Ltd., of Montreal. Three of the methods yield materi ''suitable for the manufacture of threads of artifici silk.'' Other forms also have wide use. Some are sui able for the interior lining of bottle caps and cans becau of their insoluble properties. Others can be made in clear, colorless transparent sheeting suitable for wrappi materials.

DR. SAMUEL F. HILDEBRAND, of the U. S. Bureau Fisheries, has made a detailed study of the fish fou in the Panama Canal when the locks are dewatere and reports 159 species, ranging in size from anchovi to tarpon, as well as crabs, shrimp and several other kin of invertebrates. Not all the 159 species are known pass through the canal. The water changes from salt brackish to fresh and back to salt again so that both fre water and saltwater fishes have to be able to adapt the selves rapidly to changes in both salinity and temperatur Not many fish can do this; nevertheless a considera number of Atlantic fish have been found in locks open to the Pacific, and *vice versa*.

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SCIENCE NEWS

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PROTACTINIUM YIELDS TO ATOM SPLITTING

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RARE protactinium has now joined heavy uranium and thorium on the list of elements that undergo splitting into two parts under the bombardment with neutrons.

The cyclotron at Columbia University made possible the new discovery, according to an announcement in the *Physical Review* by Professor John R. Dunning and Dr. E. T. Booth, of Columbia University, and Dr. A. von Grosse, of the University of Chicago.

Protactinium has atomic number 91, midway between uranium No. 92 and thorium No. 90. Its atomic weight is 231. Dr. von Grosse was among the first to isolate protactinium and made available the small specimen that served as the target for the neutrons shot out by the cyclotron.

Chemical separation of the "splitter" products of protactinium's fission show that rubidium and caesium are created. At the same time enormous amounts of atomic energy are released of the order of 200,000,000 electron volts and about the same order of magnitude as the energy released in the fission of uranium and thorium.

The splitting of protactinium can only be accomplished with "fast" neutrons. In this the new discovery is similar to the findings already known for thorium's fission. In contrast uranium can be split by very weak "slow" neutrons.

One hope that lies, little mentioned, in scientific reports on atom splitting and the releasing of atomic energy is that by this process atomic power might somehow be made available in a useful form. It does not appear that protactinium can serve as a "fuel"—even potentially—for such use. Releasing atomic power is possible on an economical hypothetical basis only if each splitting can somehow set off a similar fission in near-by atoms and the whole matter perpetuated by a "chain reaction." For uranium, where weakly energetic neutrons appear to have the power to do this splitting, the idea of "power" from atoms is not beyond the realm of possibility. With protactinium, however, the need for fast neutrons to do the splitting probably means that a chain reaction would not be set up and that power (in any real economical sense) would not be forthcoming.

PAPERS READ BEFORE THE INTERNATIONAL CONGRESS OF GENETICS

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GENES, the bearers of life, and viruses, that bring disease and death, may be very much alike. This suggestion was laid before the meeting of the seventh International Congress of Genetics at Edinburgh on August 28 by Professor John W. Gowen, of the Iowa State College. Professor Gowen also told of his use of x-rays as measuring tools, to get an estimate of the size of both these types of vitally important particles, which are too small to see with even the most powerful of microscopes. He found the virus particles to be super-sized molecules, with a molecular weight of approximately 16 million. This is in fairly close agreement with measurements obtained by other means. Regarding the possible essential similarity between genes and virus particles, the American scientist said: "Possibly the only difference between these small viruses and the gene is that the latter is attributed a place in the cell chromatin whereas the former is free to move, making its isolation in relatively pure form possible. But even this difference is likely to break down. With better techniques of recognizing gene effects, these substances may very possibly be found within the cell cytoplasm or even in the circulation of the animal or plant."

DEFINITE hereditary physiological traits go along with visible bodily character in different breeds of fowl, according to Professor F. B. Hutt, of Cornell University. Thus, White Leghorn hens lay thicker-shelled eggs than do heavier breeds like Plymouth Rocks or Rhode Island Reds, and they adjust more readily to changes in outside temperature. Inheritance of abnormalities in fowls, producing the seldom-seen "freak" breeds, such as Creeper and Dark Cornish, were reported by Professor Walter Landauer, of the Connecticut Agricultural Experiment Station. In these breeds there is a hereditary shortening of the leg and wing bones, producing a kind of Dachshund-in-feathers effect. In the purest-bred (homozygous) specimens this shortening extends to other bones, and the phenomenon may be so pronounced that the chick is unable to hatch at all, but dies within the shell.

SOME of the strangest cells ever seen through a microscope were described by Dr. Charles A. Berger, S.J., of Woodstock College. If twice or four times the normal number of the heredity-bearing chromosomes are found in the cells of an animal or plant, that is considered something worth mentioning at a scientific meeting. But Dr. Berger has found cells in the lining of the digestive tract of mosquito larvae that have 48, 96 and once in a while even 192 times the normal chromosome number. Ordinarily a doubling in chromosome number within a cell is the preface to division into two cells. But these strange cells in the mosquito "wigglers" just pile up their chromosome counts without dividing. Finally, when the larva is preparing to change into a winged adult, the divisions appear all at once, and the chromosome numbers go back to normal in the new cells.

IT is hard to think of an insect no bigger than a gnat being afflicted with tumors. Yet such is the case. Professor Mary B. Stark, of the New York Medical College, told of such growths which she has studied in the larval stage of Drosophila, the gnat-sized fly that is the favorite animal of geneticists. In certain strains of Drosophila these tumors appear generation after generation, in the digestive tract. They are sex-linked, appearing only in males—and they kill half of these. In another strain, the tumors appear in both sexes, but are not lethal.

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that "runs in families," and it is linked to hair color, according to Dr. Barbara S. Burks, of the Carnegie Institution of Washington. Tooth deficiency may manifest itself in any of the teeth: incisors, pre-molars, molars. Perhaps the commonest form is the failure to develop third molars or wisdom teeth. This is due to the same genetic factor that causes failure to grow teeth farther forward in the jaw. Sometimes, instead of a total absence of a tooth, the deficiency will be expressed by the growth of a very small, almost rudimentary tooth—a "peg" or "rice" tooth. Study of all available family histories, supplemented by examination of all brother-and-sister combinations exhibiting the deficiency that could be found, indicates that tooth deficiency and hair color are linked. That is, members of a family strain exhibiting tooth deficiency tend to have the same color of hair.

SUDDEN shocks of heat or cold speed the production of the abrupt evolutionary changes known as mutations, was reported by Dr. H. H. Plough, of Amherst College. With his colleagues, Drs. George P. Child and Philip T. Ives, Dr. Plough subjected the small insects, Drosophila, to quick jumps and drops in temperature. Mutations appeared at considerably higher rates than they did in control groups of the insects kept at ordinary temperature levels.

ITEMS

SUN-SPOT groups so large they can be seen with the unaided eye behind smoked glasses are now visible according to photographs taken by the U. S. Naval Observatory. Eighty spots are seen in all, arranged in seven groups. The total area of the spots covers 41.5 square degrees on the sun's surface. Since a square degree on the sun amounts to 725,000,000 square miles, the total sun-spot area now visible is about 30,000,000,000 square miles. Over 600 "earths" could be dropped into the sun-spot area that may now be seen.

PERSIMMON wilt, the new and deadly enemy of persimmon trees, has crossed the Mississippi. It has been found as far west as Oklahoma, by Drs. K. Starr Chester and W. W. Ray, of Oklahoma Agricultural and Mechanical College. Persimmon trees have a threefold importance: their wood is ideal for golf club heads and similar small objects, their fruit is one of the most important wildlife foods, and their tough, ropelike roots made them favorites with soil conservation workers as plantings to check erosion. The disease is caused by a fungus known as Cephalosporium. Its course is terribly rapid; trees usually die within a few weeks after they are attacked. There is no known cure or preventive. It is quite possible that all the persimmons of America may join the chestnut trees, wiped out by the chestnut blight several decades ago.

AMERICA'S medical schools are in better shape now than ever before to educate medical practitioners, with the aid of intern training hospitals, according to a report of the council on medical education and hospitals of the American Medical Association. In the past five years, millions of dollars have been spent to improve organization, equipment and resources of medical schools. Among the 67 approved medical schools, 24 of the lower ranking schools have added more than a million dollars to their annual budgets, an average of $47,000 each. In 20 schools the cost of improved facilities for clinical teaching has aggregated $10,000,000. There are 734 hospitals approved for internships and 518 hospitals offering approved residencies and fellowships in specialties.

NORWAY gets undeserved blame when it is named as the original home of the Norway rat, the biggest and most aggressive of man's undesired house guests. Researches of Dr. Ernst Schwarz, of the Smithsonian Institution, indicate that it was first heard from in southeastern China, but even that may not have been its point of origin. The black rat, which the bigger Norway rat bullies and persecutes, originated in a species of wild rat in the Malay region. It "adopted" man in the New Stone Age, as a house pest in India. It followed its unwilling hosts to the shores of the Mediterranean and spread thence over Europe, and to all lands where European ships have gone. Other rats being traced by Dr. Schwarz include the lesser Malay rat and the East African Negro rat, which have more restricted distribution, mainly in the tropics. Another uninvited housemate of man is the Indian musk shrew. Although this animal looks something like a mouse it belongs to an entirely different and even more primitive class of animals, the insectivores.

NEW help in tracing the family tree of the American Indian in Asia was announced by Dr. Franz Weidenreich, of the Peiping Union Medical College. His study of the bones of a family of seven, who lived in a cave at Choukoutien, near Peking, in the latter part of the Old Stone Age reveals that this family included oddly assorted types similar to types found not infrequently among America's Indians. One woman had a skull like a modern Melanesian's. Another woman's head was of modern Eskimo type. The old man of the family resembled a late Old Stone Age European, with a touch of Asiatic about him. Finding such varied types in one family in the Asiatic region from which the American Indian must have migrated, Dr. Weidenreich pointed out that "It seems no longer necessary to assume that there were immigrations differing widely according to the physical character of the immigrants and the regions they came from." In the family of seven, the woman with the Melanesian type of skull had an artificially deformed head, which leads Dr. Weidenreich to speculate that this custom may have originated in Asia. The late Old Stone Age, to which the cave family of seven belonged, lasted in Europe from about 100,000 to about 20,000 years ago.

NEW evidence that the climate in Texas was nearly the same ten million years ago as it is now can be found in fossil leaves described in a new publication on plants of Eocene geologic time, by Professor O. M. Ball, of the Agricultural and Mechanical College. The fossils described by Professor Ball were found in various locations in southern Texas, mostly in thin beds of clay. They had lain undisturbed for ages, since some long-gone autumn when they fell from the trees and bushes and were covered by the silt of a stream in flood, or settled into the muck at the bottom of a lake. Some of the best of them came from what is now a claypit for a brickyard.

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SCIENCE NEWS

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PAPERS BEFORE THE INTERNATIONAL CONGRESS OF MICROBIOLOGY

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MAN'S chemical warfare against the germs that invade his body occupied a leading part in the opening session in New York City on September 4 of the Third International Congress for Microbiology. Especial prominence was given to the powerful new weapons, sulfanilamide and its related chemicals. Just how sulfanilamide acts against bacteria is still pretty much of a riddle, it was admitted by Drs. Eleanor A. Bliss and Perrin H. Long, of the Johns Hopkins Medical School. It has been known for some time that in the presence of small quantities of the chemical, germs of the group known as cocci are not killed outright but stunned or paralyzed, so that the body's own fighting forces can make an end of them. However, in the researches reported by Drs. Bliss and Long, it has also been shown that stronger concentrations of sulfanilamide kill the bacteria outright. Another point developed was that the effectiveness of certain compounds of sulfanilamide seems to be due to their chemical decomposition, releasing "straight" sulfanilamide in contact with the bacteria.

Experiments in which sulfanilamide and sulfapyridine were used, either alone or in combination with injections of immune sera, on mice exposed to infection with meningitis, were reported by Dr. Sara E. Branham, of the U. S. Public Health Service: "In general, it may be said that, weight for weight, sulfapyridine protected mice better than sulfanilamide, and that the combination of either sulfapyridine or sulfanilamide with serum gave better protection than either the drugs or the serum did alone."

A whole family of serious diseases, including typhus fever, Rocky Mountain spotted fever and several even worse maladies from the tropics, was discussed. The diseases of this group are all caused by members of the genus Rickettsia, which are small, bacteria-like bodies of variable shape. They are usually carried about by ticks, but have also been found in the bodies of lice and other biting insects. Climate influences the virulence of three types of infection, as shown by experiments on guinea pigs and other rodents, was reported by Dr. R. E. Dyer, of the U. S. Public Health Service. Animals inoculated with the viruses of spotted fever, endemic typhus and the St. Louis strain of encephalitis showed most pronounced reactions in winter and least in summer. Some of the tests, repeated under conditions of artificially controlled air temperature, yielded confirmatory results. The Japanese representative in this family, known as tsutsugamushi disease, was the subject of a report by Professor Norio Ogata, of the Medical University of Chiba, Japan. It occurs in certain districts during the summer months, and is fatal in between 30 and 70 per cent. of all cases. Another Rickettsia-caused disease was the subject of a paper prepared by Professor Ugo Reitano, of the University of Rome. It is a form of typhus fever always present among the natives of Abyssinia, and only the most alert precautions of the Italian medical service keeps it from spreading among white troops now garrisoned there. The most effective means of combat is vaccination.

The smallest plants, no less than the largest animals, must have their vitamins, hormones and other minutely concentrated but physiologically powerful substances if they are to live and grow. Not less than a dozen such substances, according to Dr. William J. Robbins, of the New York Botanical Garden, who opened the session with a general statement. To a very large extent, microscopic plants and full-sized animals need and use the same growth-promoting substances. One such substance, only recently discovered, was given the name "coenzyme R" by Dr. Franklin E. Allison and Francis W. Minor, of the U. S. Department of Agriculture. It has been found indispensable for the growth of the nitrogen-fixing bacteria that live in the roots of clover, peas and related plants. The bacteria need very little of it; they would grow and multiply in solutions containing as weak a dilution as one part in a million. But that much at least they have to have in order to grow at all.

Other bacterial growth-promoting substances, necessary in equally minute minimal quantities, were described by Drs. P. W. Wilson and P. M. West, of the University of Wisconsin. They found the same substances present in yeast as well as bacteria. Another nitrogen-fixing bacterium, Azotobacter, that lives free in the soil instead of in plant roots, has been found to require minute traces of molybdenum, the same metal that is used in hardening modern high-grade steels, and even smaller quantities of tungsten, the metal used in electric lamp filaments. Researches establishing these facts were reported by Drs. Dean Burk and Kenneth Horner, of the U. S. Department of Agriculture.

Relationship between rheumatic fever and pneumonia has been traced by Drs. Homer F. Swift and Thomas M. Pherson Brown, of the Rockefeller Institute for Medical Research, who reported on their findings. Exudates obtained from the tissues of sufferers with rheumatic fever were cultured in various ways, both in the lungs of mice and on the embryonic membranes of incubated eggs. On the membranes the cultures produced characteristic lesions and in the mice they caused pneumonia. Microscopic examination disclosed the presence of the extremely small microorganisms known as pleuropneumonia bodies, which seem to have a size between the smaller types of bacteria and the invisible filterable viruses. Indeed, under certain circumstances the pleuropneumonia bodies themselves will slip through the invisibly fine pores of porcelain filters.

Two other strains of filterable organisms of the pleuropneumonia type, found in mice, were reported on by Albert T. Sabin, also of the Rockefeller Institute.

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From the Far East and the Near East came simultaneous reports of a bacteriological feat long considered impossible: the growing of the virus of rabies in glass laboratory flasks instead of in the brains of living animals. Professor K. Kanazawa, of the University of Tokyo, made the virus grow by feeding it minced brains of either rabbit or chick embryo. In experiments of Professor I. J. Kligler and Dr. H. Bernkopf, of the University of Jerusalem, it was grown on a medium consisting of coagulated human blood plasma and mouse embryo brain.

Cancer, at least of certain types, is caused by filterable viruses, and thereby joins a numerous and varied group of human ills, including smallpox, influenza and infantile paralysis. Three converging lines of evidence were presented by Drs. James B. Murphy and Albert Claude, of the Rockefeller Institute for Medical Research; by Drs. Jacob Furth and Elvin A. Kabat, of the Cornell University Medical College, and by Dr. F. Duran-Reynals, of Yale University. Fluids from malignant transplantable tumors of chickens were whirled in the ultra-centrifuge, passed through fine-pored filters, and otherwise treated after the manner of virus-containing fluids in known animal and plant diseases. Materials obtained from these cancer-fluid filtrates, injected into the tissues of healthy chickens, produced typical cancerous growths. In the researches reported by Dr. Duran-Reynals, chicks responded to doses of a tumor virus by developing fatal hemorrhages and degeneration of tissues, without the development of tumors. However, extracts obtained from such chicks produced the characteristic growths when injected into healthy adult fowls. Similar evidence for virus causation of cancers in rabbits was reported in communications by Dr. Jerome T. Syverton, of the University of Rochester, and Drs. John C. Kidd and Peyton Rous, of the Rockefeller Institute. A virus was indicated as the probable cause of kidney cancer in frogs, by Dr. Balduin Lucké, of the University of Pennsylvania.

African monkeys may become immune carriers of yellow fever without being bitten by mosquitoes, according to Drs. G. M. Findlay and F. O. MacCallum, of London. They introduced yellow fever virus artificially into the stomachs of monkeys and found that it retained its virulence. Other animals, including man, could not be thus converted into carriers. Apparently the high acidity of their gastric juices inactivated the virus. "If non-biting arthropods with a long life span carry yellow fever virus and are occasionally eaten by monkeys, a solution would be found of the continuance of yellow fever in dry seasons when mosquitoes are absent or rare. Attention is drawn to the survival of yellow fever virus in cockroaches."

PAPERS BEFORE THE AMERICAN PSYCHOLOGICAL ASSOCIATION

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CHALLENGING the idea that a head wound injuring the frontal lobes of the brain could leave the victim unimpaired in intelligence, Dr. Ward C. Halstead, of the Otho S. A. Sprague Institute of the University of Chicago, stated that such an injury would cause "fundamental alteration" to the personality. The report was made to the American Psychological Association meeting at Stanford University. Scientific men have recently claimed that surgical removal of even the whole frontal lobe area left patients with normal or improved I.Q. Such conclusions, according to Dr. Halstead, are "based on inadequate methods" or standards. One type of abstract thinking, involving the storing of objects into categories on an abstract basis, is "relatively unavailable," for the person who suffers a frontal lobe injury regardless of which frontal lobe is damaged. Dr. Halstead's conclusions are based on a four-year study at the University of Chicago Clinics. He pointed out that it is only recently that such experimental studies of brain injury effects have been undertaken, although analyses were made of World War gunshot brain injury cases.

Anger and other emotions can make your finger tips cold. Close links between such body changes and mental states were described by Drs. Bela Mittelmann and Harold G. Wolff, of the New York Hospital and Cornell University Medical College. As the investigators discussed with a patient the difficult situations of his life in a psychoanalytic interview, they also made measurements of his finger temperature and the behavior of his digestive system. Anger, fear, depression and elation all were accompanied by a chilling of the finger tips. Even when the patient hid his emotion from himself, it was betrayed by the body changes and by his speech. The greatest drop in finger temperature came when the patient was in a state of tension, anxiety or conflict. The maximum drop was 13.5 degrees Centigrade or about 24 degrees Fahrenheit.

Braille, the language of the blind, can open the door of the world of printed literature to those who are blind only in their inability to "see" words, was stated by Dr. Grace M. Fernald, of the University of California. In learning Braille, she found, the word-blind slightly surpassed the "control group." In all cases, word-blind subjects could then learn to read Braille with the use of only the eyes even when they were still unable to read printed words. Emotional instability is characteristic of all the word-blind individuals studied.

Rats scurrying away on hearing a warning signal, as human beings have learned to run to shelter at an air-raid siren, demonstrated the potency of relief from anxiety as a means for "stamping in" the learning of certain lessons. Psychologists have recognized how powerful fear is for inhibiting or restraining the frightened one. Escape from fear, according to Dr. O. H. Mowrer, of the Institute of Human Relations of Yale University, is also powerful in determining the course of new behavior. When the

rats in Dr. Mowrer's experiments were given a warning of impending punishment and allowed to escape from its threat, they learned better than with the aid of the punishment itself. "Human beings can take either of two courses of action in a danger situation," said Dr. Mowrer in discussing the human implications of his research with a representative of Science Service. "They can act in such a manner as to reduce the danger, or they can act in such a way as to reduce only their perception of the danger, that is, their fear."

Noise and imprisonment, as well as the dilemma of trying to make a correct decision when there is no right way, may be contributing causes to nervous breakdowns in rats. And what is true for rats may be true for men. Dr. Norman R. F. Maier, of the University of Michigan, last winter gained recognition and a $1,000 prize for causing rats to have nervous breakdowns. An animal was forced to take some action when there was no right way to do it. The driving force used in his experiments with rats was a jet of air. Now Dr. Maier finds that the noise of the air jet is a contributing factor in the breakdown. When the rats were placed on a small table and keys were jingled, the noise produced violent activity in 85 per cent.; the sound of an air jet caused it in 64 per cent. In some cases convulsions accompanied the extreme activity. Confinement is also a factor. When the rats were placed during the experiment in a closed wooden box, they were affected more than in a transparent box. But Dr. Maier sticks to his original conclusion that only the theory that breakdown occurs when a conflict is faced from which there is no escape, but in which it is necessary to take action, is broad enough to cover all the cases.

ITEMS

A 1500-YEAR-OLD pair of small iron horseshoes which probably once shod the hooves of a Swiss Lake Dweller's horse is now on exhibition at the Field Museum of Natural History. It represents the last cultural phase of the Lake Dwellers of Lake Neuchâtel. Iron horseshoes were known by the fifth century.

THE American Museum of Natural History wants a group of rare and valuable 25,000,000-year-old bird tracks just beyond reach. The museum can not afford to build scaffolding to reach up, or block and tackle to reach down, so a deposit of tracks found exposed two thirds the way up a Slim Buttes, S. D., badlands cliff, and the tracks can not be reached in any other way. A sample of what is in store for the museum and its visitors was placed on exhibition. About 100 footprints made by wading birds on the shores of lakes that vanished ages ago are included in specimens picked up at the foot of the cliff by Henry Lee, of Rapid City, S. D. They had dropped from a stratum above. Mr. Lee saw more in the stratum. It is these the museum wants.

NATURE is slowly rebuilding the Long Island beaches struck by the memorable hurricane of September, 1938, as reported by Dr. Arthur David Howard, of New York University. Last year, in a few hours, the hurricane moved back the highwater mark at Jones Beach from 300 to 400 feet, but already natural accretion of sand is repairing the damage. Airplane photographs show this repair. Many of the inlets driven through the Fire Island sand dunes have submarine bars across them already. Dr. Howard explains in the new issue of *The Geographical Review* that during calm weather sand bars pile up offshore. During a storm this sand is washed landward. Some of it goes onto the beaches and some of it goes to enlarge the submarine bars across inlet channels. Gradually the beaches will be restored.

RIGOLLET'S comet, named after the amateur French observer who "discovered" it in the constellation Taurus (July 27), is very probably identical with one found in 1788 by Caroline Herschel, sister of the great English astronomer, Sir William Herschel, herself an astronomer. This was reported by Leland Cunningham, of the Harvard Observatory, who has found that the orbit of the "new" comet checks at virtually every point with that computed by Miss Herschel for her comet. It is possible that the two are not the same, but they are definitely of the same family and very probably identical. If it is the same one, this is the first time that it has been seen since its discovery.

USE of the spectroscope to determine the molecular patterns of simple hydrocarbons and to follow the changes occurring in their photochemical decomposition was reported at the conference on spectroscopy at the Massachusetts Institute of Technology by Professor Emma P. Carr and Hildegard Stucklen, of Mount Holyoke College. They obtained experimental results on a series of simple organic molecules which are necessary for the testing of theoretical predictions. This work promises ultimately to lead to a better understanding of the energy relationships involved in a carbon carbon double bond, a problem with significant biological implications. More than 25 hydrocarbons have been examined in this research, including some containing as many as eight carbon atoms and even two double bonds. Several previously unknown relationships governing molecular structure were found.

THE compression ignition principle of the Diesel engine was invented by Malay natives at least a thousand years before it was invented in Germany. Herbert W. Krieger, curator of ethnology at the U. S. National Museum, supports this claim by showing one of the old high-compression fire lighting gadgets of the Malay Peninsula, considered probably the most efficient fire-making idea that primitive man ever thought of. It is a tightly wrapped plunger which is forced into a wooden cylinder by a blow of the hand. At the bottom of the cylinder is a bit of tinder, which lights when the blow compresses the air in the cylinder, thereby generating heat. Crediting primitive men with other brilliant inventions, Mr. Krieger says that the textile industry was saved millions of dollars of royalties when an invention for winding cord so that it could be unwound with even tension turned out to be similar to an old Fiji idea. A Fiji twine ball, in the National Museum, prevented patenting of the device.

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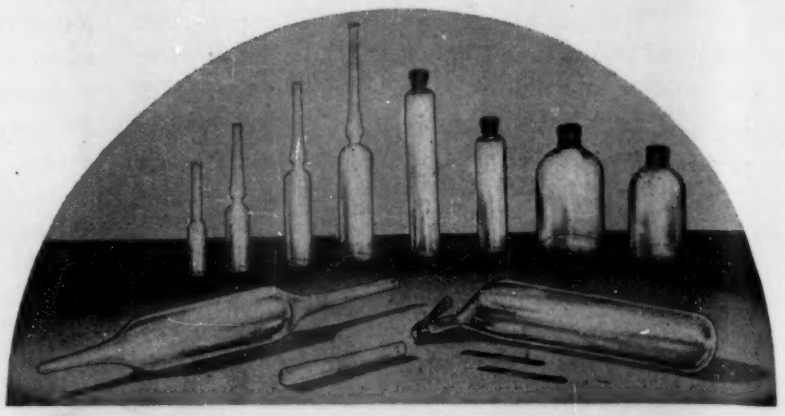

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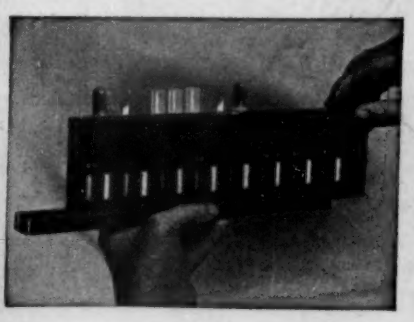

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SCIENCE NEWS

Science Service, Washington, D. C.

CHEMICAL REACTIONS WHICH OBEY THE LAWS OF CHANCE

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A "GAMBLING" type of chemical reaction, new to science, promising important developments in America's $200,000,000 organic chemical industry, was announced at the Boston meeting of the American Chemical Society, which opened its ninety-eighth semi-annual convention on September 10. It may explain even the aging of wines and liquors. The new reaction, revolutionary in its fundamental concepts, obeys the laws of chance by which mathematicians can determine the odds in games like dice, poker and bridge.

One might call the new reaction a "chemical dice game," said Dr. George Calingaert, director of chemical research of the Ethyl Gasoline Corporation, who describes the new discovery. It takes place between chemicals ordinarily considered inert to one another and without chemical affinity which is usually thought to produce chemical activity. So new is the discovery that its potentialities are as yet unrealized, but they are believed to be very important. By what is called the "redistribution reaction," chemical compounds are found to redistribute themselves into a number of compounds in the presence of a proper catalyst. It is possible to predict by the mathematical laws of chance, or probability, just what the end distribution of these new compounds will be.

The new reaction may help to explain the reactions which occur during the aging of wine or liquors. These subtle changes do occur, for man's taste is able to detect the differences. But chemical tests are worthless to measure the changes. Why they occur is still more of a puzzle. "It may well be that this aging is in fact a 'natural redistribution' among the esters which are known to constitute the flavoring portions of these liquids," Dr. Calingaert said. "If such should prove to be the case, it seems likely that a better understanding of the nature of the aging process will soon lead to improvement in the technique of accomplishing this all-important result. Simple catalysts were used throughout the experiments. These catalysts weaken intramolecular attractive forces commonly considered to be quite firm. The groups of atoms, which break loose from the molecules, interchange purely at random with other similar groups. After these random interchanges have taken place long enough, a state of 'mathematical equilibrium' is reached in which the composition of the reaction mixture exactly equals that which can be predicted by the laws of chance."

Dr. Calingaert's initial experiments were carried out in research on the nature of tetraethyl lead and related "anti-knock" compounds for gasolines. It is already known, however, that the new type of chemical reaction takes place between compounds which chemists say are inert to one another, such as gasoline and kerosene, or milk and cream. All customary signs of chemical reaction are absent. There is no formation of a solid precipitate, or a gas, or even the heat so common to many chemical reactions.

THE CHEMICAL STRUCTURE OF VITAMIN K

THE chemical structure of vitamin K has been discovered. Behind that simple announcement at the meeting of the society is the story of more, better, healthier babies, cleaner operations by surgeons with less risk, and help for one group of sick people whose blood does not clot in normal fashion. Vitamin K plays an essential rôle in making blood clot. Without it every one would be in the dangerous position of people afflicted with hemophilia, who may bleed to death from a tiny scratch. Hemophiliacs, however, do not suffer from lack of vitamin K but from a different disorder of the blood-clotting mechanism.

Two research teams of outstanding chemists, working independently at Harvard University and St. Louis University School of Medicine, have both arrived at the same structural formula for vitamin K. Using different methods, the exactness of their agreement leaves little doubt of the certainty of their findings. At Harvard Dr. Louis F. Fieser, with William P. Campbell and Edward M. Fry, synthesized the vitamin and determined the structure. At St. Louis Drs. Edward A. Doisy and D. W. MacCorquodale, with S. B. Binkley and S. A. Thayer, who were the first to isolate vitamin K in pure form, carried out an independent determination of the vitamin's structure.

The synthesis of vitamin K by Dr. Fieser's method is said to be efficient and practical for manufacturing purposes and the pure vitamin will thus be available to medicine to prevent and control hemorrhages. Dr. Doisy has also evolved a synthesis for vitamin K and found, moreover, another compound, a naphthaldehyde which is about one eighth as active as the pure vitamin but which has shown excellent results in use at the Mayo Clinic. The structural formula of vitamin K is 2-methyl-3-phytyl-1,4-naphthoquinone.

Because the blood of a new-born baby does not possess the ability to coagulate, or clot, rapidly until several days after birth, hemorrhages are among the causes of a great many injuries to infants at birth. Estimates indicate that 25 per cent. of the damages associated with birth are due to bleeding, usually through a slow seeping of the blood in the skull cavity caused by a compression of the infant's head. To prevent such hemorrhages will be one of the greatest contributions of vitamin K that now should be available widely by synthetic manufacture.

THE COLDEST REFRIGERATOR

THE world's coldest refrigerator, operating at 450 degrees below zero Fahrenheit, is in prospect as the result of discoveries reported at the opening meeting of the American Chemical Society by Professor S. C. Collins, of the Massachusetts Institute of Technology. The new type refrigerator would operate on compressed helium, the light inert gas used to inflate airships. When liquefied, helium produces the coldest cold known to man, only a few degrees above absolute zero.

Professor Collins said: "One does not ordinarily think of a steam or a compressed-air engine as being a refrigerating machine, yet the well-known principle on which they operate consists of the withdrawal of heat from the working gas and its conversion into work. Any gas expanding against a working piston is cooled by expansion. For instance, the temperature of a sample of air originally at 70 degrees Fahrenheit will fall more than 100 degrees if allowed to double its volume in an engine cylinder."

The major trouble to be overcome in a compressed helium engine is the matter of lubrication, for at 450 degrees below zero Fahrenheit all lubricants are frozen solid. Professor Collins solved this difficulty by doing away with lubricants and replacing the conventional piston of an engine with a flexible diaphragm of stainless steel. This diaphragm is sealed at its edges by a copper gasket between two steel plates. The expansion of the helium occurs between the diaphragm and one of the plates.

Two or even three such engines will be used in consecutive stages in refrigeration, for it is not practical to try to reach the extreme low temperatures in one single jump down the temperature scale.—ROBERT D. POTTER.

WORLD MAPS

THE Great Triangulation of India, most famous of all the world's mapping projects, will some day become a geodetic "Garden of Eden" for half the world's maps. This thought that the vast and careful mapping of India will be the center of origin of a far-flung network of coordinated maps for all of Asia, Europe, Australia and the Philippines was contained in the address prepared by Brigadier H. S. L. Winterbotham, mapping expert of Great Britain and general secretary of the International Union of Geodesy and Geophysics.

The address of Brigadier Winterbotham, who was recalled to England on account of the war, was read by Dr. William Bowie, formerly of the U. S. Coast and Geodetic Survey, who also took his place as general secretary.

While war will now temporarily stay the project, Brigadier Winterbotham stated that plans were being considered for pushing the century-old mapping work of India "to Australia, and the Philippines, to Moscow on the north and to Valentia (Ireland) and Casa Blanca (Morocco) in the west."

World maps, his address continued, rest on exactly known great arcs on the earth's surface which give stability and definiteness to maps as does a skeleton to a fish. Any one with competent knowledge, Brigadier Winterbotham's address stated, can carry out surveying of a small region, but it is only when each of these individual surveys can be "tied" to the general large-scale arcs of geodesy that all the little pieces will fit together exactly like parts of a huge jig-saw puzzle.

The "father" of the great mapping project in India was Sir George Everest, for whom Mt. Everest in the Himalayan Mountains was named. It was Sir George who as surveyor general of India in 1830 discovered the gravitational effect of large masses (like mountains) on plumb bobs whose timing helped determine gravity and the horizontal lines created by surveying levels. The near-by, giant Himalayan Mountains seemed at the time to circumvent Everest's astronomical observations by which he was determining latitude.

One of the great unfinished mapping projects of the world is the determination of the thirtieth meridian of longitude which runs from Cape Town to Cairo, through Africa, and later is to be extended to North Cape in Norway so that it will link the Arctic and Antarctic. Until this project is completed the mapping of Africa will be in the same stage of India at the time of Everest. "Until it is finished no lesser survey can hope to take its precise place on the map of Africa."—ROBERT D. POTTER.

PLAGUES TO COME IN THE WAKE OF WAR

INFLUENZA is almost certain to be wide-spread again if there is a general war, was predicted by Dr. Thomas M. Rivers, of the Rockefeller Institute for Medical Research, president of the New York meeting of the third International Congress of Microbiology. No effective weapon yet exists for this plague. Dr. Rivers pointed out that microbes will play a tremendous part in the war that has now started in Europe. He said no one is going to start a war of microbes. That would be next to impossible. Epidemics of influenza, typhus fever, trench fever and dysentery, however, are sure to follow in the wake of this war as they did during the last world war. Meningitis and European sleeping sickness, technically termed epidemic encephalitis, may also appear.

Dr. Rivers pointed out that medical men are better equipped to fight some of these war-born plagues than they were in 1914. Sulfanilamide, the new disease-conquering chemical, will not prevail against influenza or typhus fever, but it cures meningitis and gas gangrene. Serums also have been developed for fighting these deadly ailments.

The idea of using germs as a weapon of war is out on two counts. In the first place it is almost impossible for man to start an epidemic deliberately by releasing germs among a group of people or putting them into water or food. Not even cholera could be spread this way. Many factors besides germs are needed to start an epidemic. Even in laboratories, where conditions can be controlled far better than in communities of men and women, it is difficult if not impossible.

The second reason why germs will not be used as a weapon of war is that such a weapon would boomerang on the nation starting it. If an epidemic really got going, it would be impossible to prevent its spreading to people in the nation starting it as well as among their enemies. Germs, Dr. Rivers said, neither recognize nor stop at the front line.

NEW TREATMENT FOR CANCER

A NEW treatment for cancer has been introduced with considerable success in laboratory experiments. Almost 50 per cent. better results from x-ray or radium treatment of mouse cancers were obtained with a new "death-by-drowning technique," according to figures reported by Dr. Kanematsu Sugiura, of New York City, at the International Cancer Congress on September 12.

If human cancers react to the new treatment in the same way as the mouse cancers, the successful application of x-rays in treatment of cancer will be materially increased. Cancers so insensitive to x-rays that they can now only be killed by doses so large that the surrounding normal tissue would be damaged may some day be successfully irradiated by the new technique.

In the laboratory experiments, the mouse cancers are first bombarded with x-rays, gamma rays from radium, or the newer, faster neutron rays may be used. This increases the flow of fluid into the cell from the outside, according to one explanation of x-ray destruction of cancers. The cell swells up and its life essential chemicals are greatly diluted and eventually the cell may die.

To hasten the death-by-drowning, if that is what it is, sterile distilled water is injected into the cancer after the x-ray treatment. In mice a very small amount of the water was injected two to four times daily for three or four successive days after irradiation. Without the distilled water, an x-ray dose of 1,000 roentgens caused regression of the cancers in about 50 per cent. of the cases. The same x-ray dosage caused regression of cancers in 95 per cent. when the sterile distilled water was injected.—JANE STAFFORD.

ITEMS

SOLAR activity has been rapidly increasing with the number of spots greatly augmented, according to new photographs taken at the U. S. Naval Observatory. There were, last week, 209 spots observed on the sun, divided into 16 groups. One large group has appeared in the sun's southern latitude and it may menace foreign short-wave radio reception because of its angry character. It is believed that the increased intensity of radiation poured out by the sun at such times creates ionosphere storms in the radio reflecting layers miles above the earth. These layers act as "mirrors" for long-distance radio waves. The effect of ionosphere storms appears to "break the mirror" and cause distorted reception or even radio blackouts in severe cases.

LEADERSHIP in chemistry throughout the world is now in possession of the United States, according to a report submitted to the American Chemical Society by Professor E. J. Crane, of the Ohio State University, editor of *Chemical Abstracts*. Germany, which ranked first during the World War period and even a decade ago, has now dropped to third place with Great Britain second. Russia and Japan show striking gains. English is predominantly the language of science, the United States and England accounting for 40 per cent. of all scientific periodicals published. The report is based on an analysis of 65,000 abstracts of chemical discoveries reported last year in *Chemical Abstracts*. Chemical patents account for much of the leadership of the United States. During the last five years U. S. chemical patents have increased fifteen per cent. in number over the preceding five years. During this same time British chemical patents have declined twelve per cent., French chemical patents have decreased twenty-three per cent. and German chemical patents have dwindled to thirty per cent. of their former number.

ANTI-FLEA-BITE vaccination has been tried with "encouraging results," according to Drs. L. S. Cherney, C. M. Wheeler and Alfred C. Reed, of the University of California and the Hooper Foundation for Medical Research, in a report printed in the *American Journal of Tropical Medicine*. A group of susceptible persons has been actively immunized against the bite of this insect, which is both irritating and dangerous, since it may carry the germs of serious ailments such as typhus fever and plague. It is pointed out that "If it is possible to induce 'immunity' against flea bites, it is probably likewise possible to 'immunize' against bites of other insects. If so, this would be an extremely valuable adjunct in the control of insect-borne diseases. Insect bites may result in plague, yellow fever, malaria and other often fatal diseases, if the biting insects are carrying the germs of such ailments. The flea was chosen rather than the mosquito for the first attempts at anti-insect vaccination because it is the most common blood-sucking insect encountered in the San Francisco region. While the results are encouraging, a certain number of relapses after the immunization against flea bites have occurred, and no acute cases have been treated as yet.

PLANS for forest fire insurance are being perfected by economists attached to the U. S. Forest Service which should bring at least financial relief to the estimated $43,000,000 lost annually throughout the nation from this cause. "An unquestionably sound basis" for insuring standing timber against the menace of fire has been worked out in a report prepared by H. P. Shepard, of the division of forest economics, after a three-year study. The northeastern states and the Pacific Coast lumbering areas have already been surveyed in the research study of the feasibility of the plan. A nation-wide expansion is believed possible. For the northeastern area it is estimated that premiums of only 13.5 cents per $100 of valuation would be needed to make the plan satisfactory.

TWO new bacterial diseases have been discovered by Drs. P. H. DeBach and W. A. McOmie, of the University of California. But nobody is expected to be worried much. For the only creatures they are known to kill are termites. One bacterial species turns the heads of the dead termites black. The other turns the heads and legs red. The red disease is more than twice as deadly to termites than the black. In two lots of fifty termites each infected with the two diseases by laboratory feeding, there were twenty-five "red" deaths as against eleven "black" fatalities.

NORWEGIAN and Italian chickens of the same breed differ markedly in temperament, according to Professor N. Jaensch, of the University of Marburg. Professor Jaensch's description of the behavior of northern and southern chickens reads almost like a popular statement of the difference between Nordic and Mediterranean human races. The northern fowl, he says, walks more proudly, goes quietly and directly on its intended course; the southern bird is more excited and agitated and dashes about moving its head continually. The Norwegian chicken eats until it has had enough and then quits; the Italian can be induced to overeat if it sees its fellow-fowls picking up grain.

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SCIENCE NEWS

Science Service, Washington, D. C.

MASS PRODUCTION OF HEAVY CARBON ATOMS

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MASS production of heavy carbon, the isotope of the ordinary kind of carbon that is a basis of all living matter, was announced at the meeting of the American Chemical Society by Professor Harold C. Urey, of Columbia University.

By the chemical method of separating the heavy kind of carbon of mass 13, from ordinary carbon of mass 12, Professor Urey is now able to supply the needs of scientific workers all over the world with this valuable stable kind of carbon whose atoms can be used as tags to aid chemists in labeling parts of their atoms. By adding atomic tags at the proper places intricate reactions can be carried out and the movement, within the molecule, of the atomic tags can be deducted.

With the successful production of quantities of carbon of mass 13 (which, incidentally, you can buy at $400 an ounce) the elements hydrogen, carbon, oxygen and nitrogen are now available in their stable isotopic form for use as tags in research. These four elements are found in over 90 per cent. of all chemical compounds known, and are especially important in all biological problems.

The other way to produce tags on atoms to trace out chemical behavior is to bombard them in atom-smashing machines and render them radioactive. This radioactivity, or spontaneous disintegration, can then be detected with the proper instruments.

In an interview, Professor Urey said: "Much interest has been exhibited in recent years in artificially radioactive substances in solving important biological problems. But it really seems to me, at the present time, that most of these problems can be solved best by the use of the stable isotopes of the overwhelmingly important elements, hydrogen, carbon, oxygen and nitrogen which can only be supplied in quantity by the chemical method of the separation of isotopes. Fortunately it appears that the stable and radioactive isotopes complement each other in scientific investigation. The chemical method of separation of isotopes works best with the all-important elements, hydrogen, carbon, nitrogen and oxygen. The method of thermal diffusion and the artificially radioactive method of tagging elements works very well for the remainder of the elements in the periodic table."

While atom-smashing and the production of radioactive elements for biological and chemical experiments is the current trend in physical science there are a whole host of experiments which are lengthy ones, involving the feeding of experimental animals with isotopic materials. For all such experiments, many of them the most important in the realm of biology and physiology, it is essential to have stable isotopes and not radioactive ones which disintegrate quickly. The half life of radioactive carbon, the element found in all living matter, is only about twenty seconds. Experiments performed with radioactive carbon must be done quickly. Such haste, potentially, may lead to errors.

ROBERT D. POTTER.

MAGNETISM OF THE NEUTRON

MAGNETIC strength of the neutron, the smallest known particle without an electric charge, is 2,000 times smaller than the magnetic strength of an atom of iron. Expressed in the ordinary magnetic unit, it would require more than 20 zeros behind the decimal point before the first significant digit. Yet the results are declared to be correct within one per cent.

These results were announced on September 17 by a joint research team representing the University of California and Stanford University, which has been using the big cyclotron at Berkeley. Physicists who have worked on the problem are Professors Felix Bloch and Norris E. Bradbury, of Stanford University, and Professor Luis W. Alvarez, of the University of California.

A stream of free electrons was shot from the cyclotron at a magnetized iron plate. Those that passed through were polarized, that is, their minute magnetic fields were arranged parallel with that of the iron plate. These polarized neutrons were then permitted to strike a second magnetized iron plate. If the magnetization of the second plate was along the same lines as that of the first, the maximum number of neutrons was found to pass through it. But if the second plate was turned around so that its north pole lay in the opposite direction to the first plate's north pole, then the least number of neutrons would pass through the second plate.

To measure the strength of the neutron magnets themselves, Drs. Bloch and Alvarez simply turned the neutrons around, instead of turning the second plate. This was done by creating between the plates a magnetic field which oscillated at a radio frequency of about two million times a second. The oscillating field caused the neutrons to turn somersaults.

When the frequency of oscillation was such as to cause the maximum number of neutron somersaults, then the minimum number of neutrons passed through the second plate. A delicate counter was used to determine the precise condition of minimum passage, and from the oscillation frequency under that condition the strength of the neutron magnet was determined. In the course of the experiments 50 million neutrons were counted.

FUEL TANK EXPLOSIONS IN ENGLAND

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OUT of England's mystery of exploding gasoline storage tanks, which Scotland Yard first thought was the work of Irish terrorists, has come the amazing discovery of a species of bacteria which can live on kerosene and ferment it into ethane and methane fuel gases, just as ordinary bacteria can ferment sugar into alcohol.

At the Boston meeting of the American Chemical Society, the new discovery had chemists shaking their heads and speculating on this new-found way to let nature create for them these hydrocarbon gases which can be the starting point of a host of synthetic chemical compounds.

The new kerosene-fermenting organisms were first described informally, and totally unreported, at the meeting

of the International Congress for Microbiology in New York recently. The eminent British bacteriologist, Dr. A. C. Thaysen, of the British National Scientific Laboratory at Teddington, who is now on the high seas hurrying back for military service, described the new discovery.

His story, as related by chemists who talked with him in New York, runs like this:

Scotland Yard for months has been puzzled by mysterious explosions in gasoline storage tanks holding their wartime precious fuel. Sabotage was suspected but unproved, for the terrific explosions brought complete catastrophe. Dr. Thaysen, as the government's expert on the generation of gases by bacteria, was also called in but could find no answer. Finally, and fortunately, a kerosene tank blew up. A quick examination after the explosion showed bubbles of gas rising from the layer of water at the tank's bottom on which the kerosene had been floating. Taking some of the water and sediment to his laboratory, Dr. Thaysen discovered his new kind of bacteria which can live in kerosene and ferment it into 10 per cent. ethane and 90 per cent. methane. He cultured this organism and then sub-cultured it and obtained a pure strain of bacteria that would grow and propagate. It was the explosive methane and ethane gas generated by these bacteria which caused the explosion. While he has not yet solved the gasoline explosions he is virtually certain that a similar action occurs there too.

Chemists who understand bacterial fermentation see no reason why the discovery is not true, for they know of organisms which will live in strange places and which can ferment phenols like carbolic acid and also benzoic acid.

Dr. Thaysen is well known in his field as a careful investigator. While the new discovery must, of course, be substantiated by other workers, chemists are giving credence to Dr. Thaysen's amazing discovery.—ROBERT D. POTTER.

IMPROVED CHEMICAL TREATMENT FOR COMMON COLDS

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AN improved chemical advance in the fight against the common cold, one of the unconquered afflictions of mankind, was announced at the meeting of the American Chemical Society by a physician-chemist research team, Drs. Simon L. Ruskin and M. P. Fejos, of New York.

By the new method, drugs frequently used in treating the common cold, adrenalin, ephedrine and benzedrine, are reacted with vitamin C (cevitamic acid) to produce stable compounds of enhanced physiological action. Both the drugs for colds and the vitamin are, by themselves, unstable materials, losing their potency with relative quickness. In combination, however, they form compounds that retain their potency for over two years.

Ephedrine, used to decrease nasal secretions and "dry up" a cold, is improved by the action of vitamin C. Some of the undesirable effects of this drug—nervousness, palpitation and intestinal upset—are diminished by the vitamin C radical.

"The wide-spread use of ephedrine in the treatment of common colds," they stated, "makes the preparation of ephedrine cevitamate a definite advance in the chemistry of the treatment of the common cold and suggests a chemical rational for the wide-spread use of drinks rich in vitamin C. It similarly marks an advance in the treatment of asthma and hay fever."

The action of vitamin C on the new drug sulfanilamide is also being studied. A stable compound has been found to result from the combination. This compound has an increased solubility over ordinary sulfanilamide.

It is reported that "Investigation is proceeding on the use of sulfanilamide cevitamate for the prevention of the complications of the common cold."—ROBERT D. POTTER.

DEBATE ON THE VIRUS CAUSE OF CANCER

(Copyright, 1939, by Science Service)

CAN cancer be caused by a virus, the kind of ultramicroscopic substance that causes infantile paralysis, influenza and other baffling ailments? The case for and against this theory of cancer cause was debated by leading English and American authorities on cancer and on viruses at the closing sessions of the third International Cancer Congress.

The idea should be given very careful attention, according to Dr. C. H. Andrewes, of London. He pointed out that viruses are now accepted as the cause of some tumors in animals. There is no proof yet, he stated, that viruses are concerned in the cause of cancer in general, but the viruses have properties which fit them for the rôle of cancer-causing agents and they should therefore be given further study in this connection.

On the other hand, Dr. James B. Murphy, of New York City, gave as his opinion that there is no justification for the idea that there is one "universal virus" which causes cancers. Investigation of the viruses which cause tumors in animals is, however, interesting and important. The chief point against the idea that human cancer is caused by a virus is the failure so far to find a filterable substance such as a virus in tumors of mammalian animals (mouse or man) which can cause tumors when injected into other animals. This point was stressed both by Dr. Murphy and Dr. Andrewes.

Whether or not viruses cause cancer in man, they may provide the best lead to discovering the nature of "directive factors" in the life processes of both normal and cancer cells, and thus perhaps to discovery of what directs a cancer cell to become cancerous. This suggestion was made by Dr. W. M. Stanley, of the Rockefeller Institute at Princeton, N. J., who succeeded in isolating some viruses in the form of crystalline, non-living protein matter. The viruses represent a key to abnormal tissue changes, he said, and because many viruses are now available in essentially pure form for study, investigation of them may give the key to the abnormal tissue change that is cancerous.

Until these problems of cancer causes and prevention are solved, the practical attack on cancer rests on established methods of treatment applied as early as possible. The importance of early treatment was stressed at another session of the congress, and was summed up in survey figures quoted by the president, Dr. Francis Carter Wood, of Columbia University, New York.—JANE STAFFORD.

THE NEW ENGLAND HURRICANE OF A YEAR AGO

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HURRICANE blasts tore at New England's woods and farms and towns on September 21 a year ago, leaving hundreds of deaths and millions of dollars' worth of property loss in their desolate wake.

To-day, a glance in the direction of New England discloses a picture unexpectedly cheerful. A combination of New England grit and general American intelligence and efficiency (plus a good deal of plain, ordinary healing by nature itself) has made possible much salvage out of the wreck and a real measure of progress toward full recovery.

A survey by the U. S. Forest Service shows that 9,551 New England timber owners have nearly one and two thirds billions of board feet of timber under agreement for salvage. Actual deliveries, however, are not expected to reach much more than half that figure, for a number of reasons. Nevertheless, by next spring some 875,000,000 board feet will have been brought out of the woods, in marketable timber forms.

About two thirds of the job has already been completed. 560,401,000 board feet are already out and stored, either as logs in ponds or as sawed lumber in yards—209,120,000 board feet in the latter category alone. Something over $6,453,000, from the New England Timber Salvage Administration, has changed hands over the whole transaction. The U. S. Forest Service takes no part in the commercial transactions; its task has been to help protect the down-timber areas from fire and to facilitate handling generally.

A conspicuous factor in the success of the salvage program has been the close and effective cooperation of all parties concerned—federal and state agencies and the public at large—in preventing fire. Despite the unprecedented drought from which the entire Northeast suffered this summer, greatly aggravating the fire hazard, there have been only two fires in the whole area that exceeded 1,000 acres in extent. There were several thousand little fires—all promptly extinguished before they could spread.

The work has been carried on by an army of some 14,000 men, divided among three main agencies: 3,400 in the CCC, 7,700 in WPA and 3,064 in the New England Forest Emergency corps. There are 18 permanent camps of 50 men each, two camps of 100 men each; the rest of the workers commute to their jobs from towns and farms.

Replacement of New England's devastated woodlands is proceeding naturally. Seedlings and young saplings were not broken or uprooted by the storm, and they are already showing rapid growth. Also, last season's white pine cone crop was heavy, so there should be thick stands of seedlings of the year.—FRANK THONE.

ITEMS

FALL begins officially at 5: 50 P.M. Eastern Standard Time September 23, according to calculations made at the office of the Nautical Almanac at the U. S. Naval Observatory. At that instant the sun will be passing over the earth's equator on its southward journey which brings autumn to the northern hemisphere. September 23, too, is the day when the moon passes the planet Mars in the sky. This passing will occur at 3: 05 A.M. Eastern Standard Time.

AN extremely rich and large deposit of iron ore which contains about half of the total world iron resources will begin in 1940 to yield ore at the rate of 300,000 tons a year. It is known as the Kursk magnetic anomaly because of the immense effect that it has on the magnetic needle. The Kursk ore carries up to 67 per cent. iron content and the ore layers average 200 feet thick.

HAY-FEVER pollens ride the winds over the Atlantic Ocean, but only for a relatively short distance off shore, was stated by O. C. Durham, chief botanist of the Abbott Laboratories, after examining vaselined glass slides exposed by Engineer J. W. Etchison, of the Pan-American Airways plane, *Yankee Clipper*, on a recent trip to Europe and return. Pollens were found at altitudes between 2,000 and 8,000 feet out to 275 miles off shore. Above 8,000 feet there were practically no pollens over either land or sea. Since the plane did not fly at lower altitudes when far off shore, the possibility still remains that pollens may be present "at the bottom of the air" farther out at sea than the slides showed.

CHROMOSOMES in growing grain have their number doubled when the seed is treated with a fungicide distributed under the trade name "Granosan," Dr. Dontcho Kostoff, of the Institute of Genetics at Moscow, has discovered. Seeds treated with the compound are not attacked by fungi, whereas seeds treated with colchicine are frequently killed by these parasitic forms.

TAKING the methods of major industries, the regional laboratories of the U. S. Department of Agriculture are installing pilot plants to determine the feasibility of new methods for creating industrial materials from farm products. The pilot plants will carry new developments through the doubtful stage where manufacturers, who depend on profits, are unwilling to venture. Often the laboratory shows that a certain process can be done in the test-tube stage, says Dr. W. W. Skinner, associate chief of the Bureau of Agricultural Chemistry and Engineering. What the pilot plant does is to prove the economies for potential large-scale, commercial production.

LETTING men and machines stand idle, while nation consuming power cries out for the things they might produce, is a worse waste of national resources than stripped timberlands or soil erosion, according to a report of the National Resources Committee, under the editorship of Gardiner C. Means. "Manpower, potential work, is a perishable resource like water-power," the report points out. "Ten or fifteen million idle workers combined with idle machines can mean a tremendous loss in potential national income. In addition, the failure to use available manpower reduces the effectiveness of future production as idleness breeds frustration and loss of skills. The magnitude of losses from waste of manpower throws the wastes in the exploitation of natural resources into insignificance."

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SCIENCE NEWS

Science Service, Washington, D. C.

THE EXPECTED METEOR SHOWER

ASTRONOMERS are hoping that there will be an extraordinary display of shooting stars or meteors on October 9 or 10, although they are trying not to raise anticipation too much by making definite predictions.

Just six years ago, on October 9, 1933, there was visible in Europe for a few hours the strongest meteor shower of this century. It was one of those heavenly performances that one is lucky to see once in a lifetime. Astronomers figured out that the earth had passed through the region of space occupied 80 days previously by the faint, short-period comet Giacobini-Zinner. The meteors were produced by bits of débris tagging along in the same orbit as the comet. Since the period of this comet is 6.6 years, it is again due in the vicinity of the earth. This year the earth precedes the comet to the point where their paths cross by 136 days. In 1940 the earth follows the comet by 229 days. In either case there is a chance that there will be a recurrence of the Giacobinid meteor shower.

Dr. Fletcher Watson, of Harvard Observatory, finds that the earth reaches a favorable position for a shower on October 9 or 10, if the comet has not varied too much from its previous path, which it may have done. He suggests that observers over the whole earth be alert during those evenings so that any display of meteors can be properly recorded.

Any careful, observant person can make useful records. Here is how to go about it. Get out in the country where street and house light will not blind you for the majority of the meteors will be faint. Record the magnitude or identity of the faintest star you can see. If the transparency of the sky changes appreciably during the observations, record the changes. Watch some definite region of the sky, such as the polar region or the zenith, directly overhead. Count the number of meteors seen during intervals of five minutes. At least once each hour, over intervals of not less than five minutes, count the number of meteors of each magnitude. Determine as closely as possible the position and size of the area from which the meteors seem to come. If low-power binoculars are available make observations of the number of meteors of various magnitudes seen through them. Send in a full record of your observations to Science Service, Washington, D. C., for transmission to astronomers who will study them.

An extraordinary display of the Giacobinid meteors may occur in 1946 because then the earth and the comet are expected to be only eight days apart in reaching the same position. But astronomy has not yet lived down the failure of a much-heralded Leonid shower in 1899, which just didn't happen. For that reason, while hopeful, astronomers are not being dogmatic about the chances of seeing the Giacobinid shooting star shower, either this year, next year or in 1946.

RADIOACTIVE TRIPLE WEIGHT HYDROGEN

HYDROGEN of triple weight variety has been made radioactive in atomic bombardment experiments with the University of California cyclotron. It is a strange kind of hydrogen of mass 3 with a long half-life period of radio activity and a very short range for the radiation given off from it.

Drs. Luis W. Alvarez and Robert Cornog obtained the evidence as a follow-up on atom-smashing experiments that showed an unusual kind of helium of mass 3 instead of the usual mass 4 is stable. The research also showed mass 3 helium to be about 12 times as plentiful in helium obtained from the atmosphere as in helium extracted from gas wells.

The helium of mass 3 when used as a bombarding material induced radioactivity in ordinary silicon of mass 2 probably forming phosphorus of mass 30 which broke down into silicon of mass 30 with release of electrons. The radioactive mass 3 hydrogen was produced by bombarding deuterium (hydrogen of mass 2) with deuterons (hearts of mass 2 hydrogen) by means of the cyclotron.

Ordinary hydrogen is the simplest element of unit weight or mass one. It is one of the components of water and almost all living and many non-living things. Helium is the next heaviest element, usually of mass 4, and only in recent years has it been available in quantity for use in airships, diving and medicine. The report is published in the *Physical Review*.

AIR SANITATION

MEDICAL science may be on the verge of conquering epidemics of respiratory diseases, such as influenza, colds, etc., by keeping the air clean. Just as typhoid and other water-borne ills were brought under control by successful sanitary measures of control, so the next great advance in disease prevention may be air sanitation.

At the University of Pennsylvania Medical School there is in progress a special investigation of air-borne infections. One result is the idea that it is not alone the droplets sprayed in the air by coughs and sneezes that carry diseases, but the nuclei of the dried droplets that float in the air.

Respiratory infections are must less frequent in spring and summer than in winter because open windows change the air 100 times an hour compared with below 10 over turns per hour with the closed doors and windows of winter. If air disinfection in winter can accomplish similar hygienic results, a long step may be taken in air-borne disease control.

One of the most promising methods of air disinfection is through use of ultra-violet lamps that create invisible screens of radiation barring and wiping out the germ-laden bits floating in the air. Already used in hospitals to barricade sickrooms against release or entrance of infection they promise to have wider use, even in homes and public places.—WATSON DAVIS.

HEARTWORM INFESTATION OF DOGS

A NEW drug to combat the rapidly spreading heartworm infestation of dogs will shortly be made available to veterinarians. The drug, antimonial-III catechol

licylic acid sodium, is the result of three years of in-nsive research by James A. Austin and Dr. Harold P. rown, of Kansas City, Mo.

Heartworm infestation of the dog is a unique disease ecause living adult worms, *Dirofilaria immitis*, 8 to 12 ches long, situate themselves in the right heart. Under eatment the adult worms are slowly killed by gradually ilding up a concentration of trivalent antimony in the ood stream of the dog. The selective habitat of the ult worm in the right heart is a fortunate arrangement r the dog, for if the Dirofilaria were located in the left art they would, upon being killed, pass into the aorta d its branches and the dog would succumb to a general-d embolism. Owing to the rich blood-supply of the g, this organ is usually capable of coping successfully h the task of absorbing the dead filariae.

The ill effect of heartworm infestation upon the host is entirely due to the presence of the adult worms in the art. Larvae liberated into the blood stream also damage dog. These larvae, or microfilariae, 0.2–0.3 millimeters length, are worm-like in appearance, and move through blood with a whipping motion.

One 27-pound dog with a fairly heavy infestation pre-ted a count of 186,000 microfilariae per cubic centi-er of blood, or approximately 175,000,000 heartworm vae in its entire blood stream. Laid end to end these rofilariae would stretch a distance of 30 miles. Upon opsy, the right heart and pulmonary vessels were mmed full of the adult worms. A rough estimate of adult worms would place the total length of worms he heart and blood vessels at about 100 feet.

Heartworm infestation can not be transmitted directly m dog to dog, but must pass through an intermediate t. The mosquito has been indicted, and the tick, flea other biting and sucking arthropods and insects are pected. Treatment of the condition involves a series graduated daily doses of the drug administered intra-ously.

ITEMS

ENGLAND is investing nearly $30,000,000 in a new plant the production of petroleum by the hydrogenation of , it has been learned by *Industrial and Engineering mistry*. The plant, the second to be built in Great tain, is to be financed by government capital with the perial Chemical Industries, Ltd., the management cor-ation. The I. C. I. already operates the large coal-rogenation plant at Billingsham-on-Tee for the pro-tion of gasoline.

ALL medical officers of the British Royal Air Force have instructed that no one should be allowed to fly or to e an automobile while taking sufanilamide or related mical remedies. Derivatives of these chemicals, by ducing methemoglobin or sulfhemoglobin, may inter-with oxygen exchange of the blood and so prove a ger by reducing oxygen supply to the pilot's or er's brain. Peace-time experience shows that a full of one of these sulfanilamide derivatives taken tly before flying lowers an aviator's "ceiling" by t 5,000 feet. Dr. E. P. Mackie, medical adviser of Imperial Airways, saw a pilot who was suffering from severe oxygen lack as a result of flying at only 13,000 feet. Investigation showed he had been taking full doses of sulfanilamide for tonsillitis. Similar cases have been observed in America and Germany. The British experience is reported by a correspondent of the *Journal* of the American Medical Association.

RUST fungi, among the worst parasitic enemies of wheat and other grains, may possibly give their host plants something in exchange for what they take. Dr. Branquinho d'Oliveira, of the National Agronomic Station at Lisbon, reports in *Nature* the results of experiments suggesting that rusts can capture and fix nitrogen from the air, as do the bacteria that live in the roots of plants of the pea and clover family. Dr. d'Oliveira grew wheat seedlings on laboratory media from which all nitrogen had been carefully excluded, so that the customary supply of this vitally necessary element could not be obtained through the roots. Then he inoculated part of the plants with spores of various species of rust. After a time he analyzed the plants. The infected ones proved to have a slightly but definitely larger nitrogen content than the control plants that had grown up free from rust.

BENEFITS of protection to migrating hawks and other useful birds of prey at Pennsylvania's famous Hawk Mountain are shown in the first annual report of the association formed to acquire and develop the critical two square miles of crest land, where gunners used to station themselves to shoot the birds "just for fun." Although the Hawk Mountain Sanctuary Association has been functioning officially for only one year, close counts on the migrating hawks and eagles have been kept up since 1934. They show fluctuations in numbers of particular species, but the net totals have climbed from 10,776 in 1934 to 17,024 in 1938. (The 1939 migration has not yet taken place.) The biggest increase has been in numbers of the broad-winged hawk, which preys chiefly on rodents, reptiles and amphibians. In 1934, 2,026 of this species were counted at Hawk Mountain; the 1938 count was 10,761. Hawks and eagles in general are useful birds, destroyers of rodents and other vermin, explains Mrs. C. N. Edge, through whose activity the sanctuary was established. Only a few species are chicken thieves and hunters of the game birds which man considers his especial prerogative.

AMERICAN chemists now have ready more than 500 dyes for tinting the new Nylon stockings, made from coal, air and water, which soon will be on the market, according to the report of P. H. Stott, du Pont chemist, to the meeting of the American Association of Textile Chemists and Colorists. Originally created for use on wool, silk and acetate rayons, the dyes work equally well on the new synthetic, silk-like fiber. The introduction of Nylon and its dyeing, Mr. Stott indicated, is in sharp contrast to the struggles of the then-new rayon industry during the World War. At that time the industry was completely dependent on German dye imports and had difficulty in getting good dyes after the conflict began.

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The general anesthetics are taken up first. Following this is a group of drugs chiefly characterized by their action on the central nervous system. After these comes a series of substances possessing specific actions on some one or more parts of the involuntary nervous system. These are followed by drugs which act mainly on the circulatory system, then follow the antipyretics, a few miscellaneous drugs, and finally a few experiments on acids, alkalies, and some of the heavy metals. The section on materia medica follows the work on pharmacodynamics.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SCIENTIFIC AND EDUCATIONAL ORGANIZATIONS OF WARSAW

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As the smoke of devastation slowly clears away from the ruins of Warsaw, the world of science and learning is anxious to learn what has happened to the centers of scientific research and education in what was once the capital of the Polish republic.

No word has come out, during all the days of the furious siege, of what was happening to the University of Warsaw, alma mater to 10,000 students, with its magnificent library of 800,000 volumes. Has it shared the fate of Louvain University in the World War, of the University of Madrid during the Spanish insurrection?

However, even if by some miracle it escaped total destruction by bombardment and fire, the university is certainly ruined, and with it the dozen or so other special and technical schools that brought the total academic population of Warsaw up to about 20,000. For research and education must have students and teachers and both faculties and student bodies must now be either dead or prisoners or in exile.

Although the University of Warsaw is only a little more than a century old it has had a checkered career. It was founded in 1816, only to be closed in 1831. Reopened in 1862, it ran for only half-a-dozen years before it was closed again in 1869. Reorganized as the Imperial University of Warsaw in the following year, and renamed simply the Polish University in 1915, it has continued in operation and grown rapidly since the end of the World War and the repulse of the Bolshevik invasion in 1920.

Similar disruption of activities must have been the lot of other Polish institutions, notably the ancient University of Krakow; although at that place there probably was no major destruction of physical equipment because of the quick capture of the city by the Germans.

Because Krakow was the ancient capital of Poland, the Polish Academy of Sciences had its headquarters there. This organization, corresponding to the National Academy of Sciences in the United States and the Royal Society in Great Britain, is another scientific casualty of the new war.—FRANK THONE.

WEATHER FORECASTS IN EUROPE

(Copyright, 1939, by Science Service)

WEATHER, which regularly migrates from west to east, is proving an ally of the Allies in the present war, as it did in 1914–1918. Britain and France know what the weather is going to be like over Germany before the Germans themselves know, and can plan their military operations accordingly.

The British and French have this private foreknowledge of German weather because they get the same weather first. Storm centers and areas of fair weather that eventually reach Germany cross Britain or France on the way, or at least some stretch of ocean patrolled by Allied warships and open to non-German commercial shipping, from all of which weather information can be obtained for Allied use but denied to Germany.

To be sure, German submarines may possibly be sending weather information home by radio, but that would be a risky procedure, with British and French destroyers and aircraft constantly on the alert to pick up any hint of a U-boat's whereabouts. And if the anti-submarine campaign succeeds completely, as the British Admiralty claims it will, even this slender source of weather information would then be lost to the Reich.

In the meantime, every effort is being made in Britain to deprive the Germans of any possible crumb of weather information. Publication and broadcasting of weather data are strictly forbidden; not even the occurrence of a local thunderstorm may be mentioned. Public forecasting in the islands has undergone a complete black-out, lest the enemy glean any helpful information from it.

Weather broadcasts are still being radioed from such places as the Azores, Greenland and of course the United States; but these are too remote to give German meteorologists any real help. And the coastal countries—Belgium, the Netherlands and Denmark—are too near and too small to be of any use.

Weather knowledge has become of immense value in war. Before a major offensive is launched the general staff wants to be assured that it will not bog down in mud. Before an air raid takes off, or a naval move is undertaken, the chances of storm, cloudiness, fog and high wind must be determined. Chemical warfare is notoriously dependent on wind and the chances of rain. Meteorologists have taken the place of the augurs and soothsayers who used to go with the armies of antiquity.

Accounts of the successful British air raid on the Kiel Canal area indicate that it was timed on a knowledge of weather probabilities. The pilots' stories of taking off in clear weather, flying into rain and swooping out of clouds to loose their bombs on German warships and shore works all suggest rather strongly that English weathermen knew where a helpful storm area might be centered.

The converse of this story is one from World War days, of a pair of Zeppelins that started from their German base in what looked like good flying-and-bombing weather, but ran into a storm of which they had no warning and were both lost in the North Sea.

In old sailing-ship days, a fleet about to go into battle sought to get the "weather gage" of its opponent, that is, to maneuver into a position to his windward. The geographic position of England and France would seem to give them a permanent weather gage of Germany.—FRANK THONE.

THE NUTRITIONAL PROBLEMS OF GERMANY

GERMANY'S new brightly colored food cards limiting rations of meat and other staples are likely to spell malnutrition.

The new tightening of the belt imposed on the civil population—the second notch drawn in since the war started—means that Germans will have a diet less adequate in fats and milk than the subsistence diet worked out in America. Nutritionists here emphasize that the subsistence level of diet is for emergency only. It shows the

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best apportionment of small funds to buy food, but may not maintain health over any protracted time.

The American subsistence diet calls for a pint of milk a day for children; and for adults, half a pint or more than two ounces of cheese such as American cheddar type. Germany now restricts its milk ration to children, allowing those under six a full pint and a half a day, those between six and 14, a half pint a day. Older teen age boys and girls whose bone formation is in rapid progress get no milk allowance. Like adults, they have only a cheese allowance, and that is a mer› two ounces for a whole week. One egg a week is recommended on the subsistence diet by American nutritionists, and one egg a week is about what Germans can buy, although there is no ration card limiting purchase.

The protective foods, such as milk, green vegetables, oranges, tomatoes, are important in any diet for warding off malnutrition, and are included even in the most economical budgeting by American nutritionists. Germany's garden crops are something of a question mark here, but it is considered unlikely that farms and freight trains are supplying civilian markets with adequate amounts of green produce, though Germany's community gardening may help out.

Americans, while not faced with Germany's ration card problems and shortages, are increasingly interested in warding off malnutrition. Farmers' Bulletin 1757, which discusses "Diets to Fit Family Income," is a "best seller" of the Department of Agriculture's current publications. As a free document it is now exhausted and a new free printing is in the presses, but orders at five cents a copy are being received and filled at the Government Printing Office. This is the publication of 1936 in which Dr. Hazel Stiebeling worked out four diet levels for American guidance: the emergency or subsistence diet, the minimum diet (not recommended for America, but the best apportionment of money at the lowest level to maintain health), the moderate diet and the liberal or more attractive and expensive diet.

CANALS LINKING THE ATLANTIC AND THE PACIFIC

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IF plans for the Nicaraguan Canal, now revived, actually get to the digging stage, America will have achieved three out of four much-talked-of canals for linking the Atlantic and Pacific.

The four main canal routes which have at various times been considered by American engineers are: *First,* the Panama route, now a 25-year-old reality. *Second,* the route across southern Nicaragua, linking in the San Juan River and Lake Nicaragua. Planned as far back as 1825, this project is now being studied in conference by the Nicaraguan Government and its neighbor Costa Rica, while American engineers are again at the task of surveying the ground problems. *Third,* the route across the narrowest part of Mexico, the Isthmus of Tehuantepec. A canal at this point, so much nearer the States than Panama, would bring Honolulu more than 1,200 miles closer to New York. *Fourth,* a route farther south than any of these, across Colombia near its Panama border. This route actually has once been dug—dug and practically forgotten. It was America's first achievement joining the oceans, undertaken with no thought of significance, by a Spanish monk, Antonio de Cereso, Indian laborers back in 1788.

Recent discovery of an old map showing this cana reported by the WPA historical records survey. Prem F. Becnel, going over historic documents at Tulane U versity's Department of Middle American Research, earthed this map, and realized its historic value. C tinuing the search for more records of the Canal Raspadura, as it was called, Mr. Becnel and a resea student assistant have since found eight more maps sh ing the canal and have traced its history. It joined San Juan River, which has an outlet on the Pacific, w a tributary of the Atraro River, which flows into the G of Darien on the Atlantic side.

America's first ocean-to-ocean canal was dug, not trade, but to settle a boundary argument between families. It was a shallow ditch, but during periods high water Indians began to find the route handy in t canoes, thus unknowingly becoming first to take a sh cut water route from one coast of America to the ot Cacao beans for Indians and white people were the ca commercial cargoes that crossed the continent *via* canal.

A Philadelphia engineer in 1852 found the Raspad ravine route so filled up that even his light-draft canoe to be dragged through a canyon on dry land before could get to the San Juan River and the Pacific.—Em C. DAVIS.

THE TREATMENT OF INSOMNIA

VITAMINS are replacing sleeping medicines in the n est treatment of insomnia or sleeplessness, reported by Louis J. Karnosh, Western Reserve School of Medicine the *Journal* of the American Medical Association.

The vitamin treatment may, in fact, be looked on a cure, since it attacks an underlying cause of the condit whereas the sleeping medicines are palliative. The ph cian using this treatment, however, does not rely o glass of fruit juice at bedtime to put his patient to sl The vitamins are given like medicine, sometimes injec into veins, and in large doses, rather than merely as p of the diet.

B_1, the anti-beriberi vitamin of yeast, and C, or ascor acid, the citrus fruit and tomato juice vitamin, are ones particularly recommended in this report of the new ways of attacking both ordinary sleeplessness and the somnia that accompanies certain diseases, including lirium tremens.

"Vitamin B_1 should be looked on as the perfect seda for delirium tremens," Dr. Karnosh declared. Ascor acid, the vitamin C principle, is a serious rival of vita B_1 as the "ideal sedative" for exhaustive states, such occur in patients with the severe thyroid disease or go known as thyrotoxicosis. Ordinary insomnia, irrespect of its cause, also yields to large doses of this vitam This treatment produced a "sound and normal sleep there were no undesirable after-effects and in some ca a normal sleep rhythm was established for a week or m Dr. Karnosh says, summing up a report of another ph cian who treated more than 100 insomnia sufferers with C vitamin.

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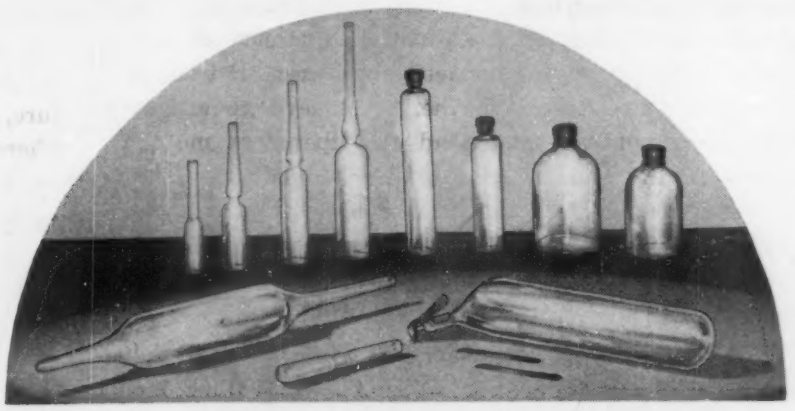

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Dr. Karnosh advises treatment with both vitamins B_1 and C to ward off the insomnia incidental to hardening of the brain arteries and senile decay, particularly because old people are likely to be short on vitamins. Rather than giving large and continued doses of ordinary sedatives, Dr. Karnosh believes vitamins should be used to treat sleeplessness in heart disease, in the weakness following infections and in all exhaustion states which deplete the nervous system.

THE CHEMO-SCORE

AT Kansas State College, where a new system of examination grading is in vogue, if the student's answer is wrong it turns red; if it is correct the answer turns blue.

This method of grading, known as the Chemo-Score, was invented by two brothers, Dr. H. J. Peterson, of State Teachers College, Hattiesburg, Miss., and Dr. J. C. Peterson, of Kansas State College. Printed with two moisture-sensitive black inks, the correct and incorrect answer spots are initially indistinguishable, but when moistened they change color immediately. The student records his choice of answers by touching with a fountain pen which contains water instead of ink, or with a moistened paper clip, the spot which represents his chosen answer to each question. If his choice is correct the answer spot turns blue, if incorrect, it turns red.

A transparent answer sheet is used in correspondence work. To develop the answer spots on such a sheet the student dips a roughened pin in water, thrusts it through the sheet at the desired location and works it up and down a few times. The pin is removed and the perforated spot pressed between the thumb and forefinger. This causes the color to spread.

This self-instructor type of lesson calls for no writing whatsoever on the part of the student. For a three-hour course in psychology, the student works out 10 sets of problems and questions, using 10 accompanying self-instructor cards to record and check the answers.

After studying the assignment, the student takes up the problems one by one and checks his answers on the self-instructor cards. If his first answer is wrong, he will be informed of that fact by the red color reaction which issues from the spot. Directions call for him to re-read the relevant text material, study more intensely than before, and make another trial answer. The student continues until he gets the blue color reaction, signifying the correct answer. The uniqueness of the method compels and holds interest.

A "Play Your Way Reader" utilizing the same principle, has also been prepared by the Peterson brothers. With practically no assistance the child eagerly "plays his way" into a reading acquaintance with 120 common words. Each line in the book contains a problem and consists of a picture and four words, one of which names the pictured object. The word in each line which names the pictured object turns red and the others turn blue. Thus, the child can test his own solution to each problem.

This immediate check-up on every response serves to intensify interest and hold attention. It presents to the child, just when the word and its meaning are most vividly associated in his mind, the assurance that they belong together, or, if his choice is erroneous, he sees [his] mistake. This assurance, accompanied by the interest [it] creates, is probably the most powerful factor in learning that is known to psychology.

ITEMS

THE number of World War soldiers who are patients in hospitals for mental disease is still going up and will continue to increase, it is estimated, for another eight years. In 1929, a decade after the war, 18,393 veterans were hospitalized for mental disease. Now, another decade later the number has gone up to 29,000. By 1947, it is estimated by the U. S. Veterans' Bureau, the peak will be 40,000. This figure does not include a much larger number suffering from mental and nervous diseases, but who are kept out of hospitals. The total number of World War veterans receiving compensation for neuropsychiatric disease on January 1, 1929, was 54,785. It is now 89,119, in which 67,366 cases are directly traceable to the war.

A NEW departure in weather forecasting is being tried at the district office of the U. S. Weather Bureau at the Kansas City airport. If it works out satisfactorily it may be extended to other Weather Bureau stations throughout the country. The new procedure, which went into operation on October 1, consists of making aviation and general weather forecasts at the same station, by the same staff. Hitherto, aviation weather forecasts have been made by special staffs working at airports, while the general forecasts were made independently at the old downtown Weather Bureau offices. The new system, it is hoped, will save expense through elimination of duplicate equipment and through a better scheduling of the time of the personnel. A possible drawback, which must be avoided if the new system is to function properly, might be simultaneous demands for both aviation and general forecasts.

GLOWING colors in autumn leaves are due mainly to three kinds of pigment. Reds and purples come from a substance called anthocyanin, in solution in the cell sap. This is the same coloring matter present in beets, red cabbage and most deep red flowers, like dahlias and cannas. Yellow tones come from tiny solid pigment bodies made up of either xanthophyll or carotin. These are always present in the leaves, but during the summer are masked by the stronger hue of the green chlorophyll. When the latter pigment breaks down and becomes colorless the yellow hues come into their own.

WILT-RESISTANT alfalfa varieties, developed under a long-range breeding program by the U. S. Department of Agriculture, will be available to limited distribution in 1942. The new alfalfas are being produced by crossing resistant strains, brought from Turkistan by H. L. Westover, with varieties already established in the United States. Alfalfa wilt began to become a serious problem in this country about 15 years ago. Up to that time, a good stand of alfalfa could be counted on to last from 6 to 12 years without reseeding, but lately the wilt organism has been wiping out alfalfa fields in from two to four years.

Six Noteworthy New Books

Propagation of Horticultural Plants

By GUY W. ADRIANCE and FRED R. BRISON, Texas A. & M. College. *McGraw-Hill Publications in the Agricultural Sciences.* 314 pages, 6 x 9. $3.00

In this book the reproduction of plants, for commercial or home planting, is considered from two viewpoints: (1) production of seeds and growing and handling of seedlings; and (2) the various methods of asexual propagation, involving the use of plant parts. Forcing structures and other equipment necessary in the growing of plants are illustrated and described. The most recent practices relative to the propagation of specific plants are included.

The Management of Farm Woodlands

By CEDRIC H. GUISE, Cornell University. *American Forestry Series.* 352 pages, 6 x 9. $3.00

This book provides the technical information required in the solution of the problems of woodland management and in stimulating good silvicultural and utilization practices. The material is applicable to farm woods of several acres as well as to the larger woodlands not sufficiently extensive to be included in commercially operated forests. Although the book has been prepared with the eastern United States especially in mind, the principles as outlined in the text will apply throughout the entire country.

History of Chemistry. *New third edition*

By the late F. J. MOORE. Revised by WILLIAM T. HALL, Massachusetts Institute of Technology. *International Chemical Series.* 447 pages, 5½ x 8. $3.00

As before, this book gives a treatment of the historical development of the important theories of chemistry which covers the origin of the fundamental ideas of the science, their philosophical basis, the critical periods in their development, and the personalities of the great men who have contributed to that development. In the new edition equal emphasis has been given to all phases of chemistry; more attention is paid to the work of American chemists; and greater stress is placed upon recent progress in the field.

Principles of Metallography. *New fourth edition*

By ROBERT S. WILLIAMS and VICTOR O. HOMERBERG, Massachusetts Institute of Technology. *International Chemical Series.* 339 pages, 5½ x 8. $3.50

In the new fourth edition of this widely-used textbook the authors retain the dominant purpose of previous editions: to meet the needs of those students of general science or engineering who do not intend to specialize in metallography, but who expect to use it in connection with their professional work. There is an important new chapter on plastic deformation and annealing of metals, and the section on aluminum alloys has been completely revised and brought up to date.

Laboratory Studies in Zoology. *New second edition*

By the late H. D. REED, and B. P. YOUNG, Cornell University. *McGraw-Hill Publications in the Zoological Sciences.* 207 pages, 6 x 9. $1.50. Outline plates to accompany the manual, 75¢.

Intended to give the student a knowledge of all the fundamental biological principles, this manual introduces the study of the frog as a means of inculcating the principles of bodily organization; the services rendered by bodily components; the nature of protoplasm; the importance of the cell as a vital unit; and the organism as a totality and superior entity. Directions for most of the studies have been entirely rewritten and enlarged. The series of outline plates has been revised and several new plates have been added.

Engineering Materials

By ALFRED H. WHITE, University of Michigan. 547 pages, 6 x 9. $4.50

Approaching the subject from the modern theoretical standpoint, this new book discusses plastics, protective coatings, corrosion, fuel, combustion, water softening, and the newer alloys, as well as the older types of ferrous and non-ferrous metals, clay products, cement, and concrete. The treatment stresses the relationship of properties of materials to their atomic and crystalline structure.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE DISTANCE OF THE STARS

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MORE than 5,000 stars nearest to the earth are only a half or a third as far away as astronomers have previously believed, is announced by Professor Jan Schilt, head of the department of astronomy of Columbia University. By analyzing thousands of determinations of distances of the "nearer" stars, made by the method of parallaxes, Professor Schilt has found a small systematic error which changes the calculated distances by a factor of from two to three.

Parallax is the method by which the distances of the nearer stars are computed, particularly those of the earth's galaxy. The parallax method is based on sighting the angle of the star in the sky at intervals six months apart and then computing its distance by trigonometry.

By examining the stellar parallaxes obtained through many years by many astronomers, Professor Schilt has determined small correction factors which occur systematically. Although it is only a working hypothesis, Professor Schilt suggests that the tides in the earth's atmosphere, caused by the pull of the moon, change the bending ability of the air for the light from the star and make the determinations of position slightly in error.

It is also suggested that the effect of sunlight passing through the air about the earth would warm it slightly and hence create "waves" that might change its bending ability. A combination of the moon and sun effect is believed to produce the errors. For any individual measurement the systematic error thus introduced is much smaller than the error of observation. Only by taking large numbers of observations and analyzing them statistically can the systematic error be detected.

While the new findings tend to shrink the known limits of the galaxy of stars containing the sun and earth, the discovery does not mean that the limits of the universe are likewise decreased. This is because the distances of remote stars are not determined by the parallax method but by means of the luminosity law which relates their brightness with their distance.

The new knowledge is expected to take the galaxy of stars to which the sun belongs out of the special category in which it has been placed. Because the new findings "move in" the stars, the number of them to be found in a cubic volume of the galaxy is increased. Previously it has been supposed that the sun's galaxy was "thinner" and had fewer stars per unit volume than other island universes out in space. The new discovery brings the sun's galaxy more in line with the characteristics of other galaxies.

It will be necessary to recompute the distances of all stars for which the method of parallaxes has been employed since the method was first introduced by the German astronomer, Friedrich W. Bessel, in 1838. Because of the systematic nature of the new correction, only recalculation will be needed without taking new observations on each star.

A NEW KIND OF EARTHQUAKE WAVE DISCOVERED

A NEW type of earthquake wave, which is expected to alter radically now-accepted seismological theories and the allied concepts of building quake-proof structures, has been discovered by Dr. L. Don Leet, director of the Seismograph Station of Harvard University. The find is also expected to be of special military importance, since it will probably vitally affect the use of the seismograph in army artillery observation, which employs earth tremors as guides to the sites of heavy enemy guns. They are also used to check the accuracy of the army's own firing. Both the discharge of a cannon and explosion of a shell start underground vibrations which can be traced on earthquake recording instruments.

The new wave-form was detected after a ten-year study of man-made earthquakes, touched off by high-power dynamite explosions. Dr. Leet said that the new type vibration, entirely unpredicted in earthquake theory, is the fifth fundamental type known to science.

The four forms previously known have been recognized for about forty years and it was surprising to find a new type, especially since in many types of explosion-shocks the new form is dominant, registering strongly on the instruments while the other four forms hardly leave their marks. The new form is a sort of surface wave which travels through the upper 200 miles of the earth's crust, in contrast to the deeper waves which travel directly through the earth's core. It is the third fastest of known earthquake waves. Those through the earth's center are the speediest, and they impart a push-and-pull motion to particles in the path. Another internal wave, which shakes the particles from side to side of the wave-path, is second-fastest.

Then comes the new wave, which drives particles at a diagonal to its path, followed by another surface wave, with a side-to-side motion, and finally, the slowest wave of all, a surface wave which drives the particles in a curious sort of elliptical rotation. Dr. Leet has timed the new wave going about 2,500 feet a second when set off by dynamite in sandy ground, but he pointed out that this speed might be considerably different under other conditions. Thus far the new wave form has been observed only on dynamite-explosion records, not on natural quake-charts, but Dr. Leet said it is "almost certain" that it will eventually be found among natural tremors. In all other respects, he pointed out, natural and artificial quakes are similar.

An important problem arising from discovery of the new wave, and one which Dr. Leet is now investigating, is how much damage this new type of wave does. If it is mingled with the waves close to the sources of earthquakes, which cause heaviest damage, it may be necessary to change the design of quake-proof structures to withstand the ground conditions set up by the new wave.

The discovery may also have important implications for the science of geology, for many of the assumptions which

"This book marks a new era in the development of ecology."

—PROFESSOR ERNEST C. DRIVER, *Smith College*

BIO-ECOLOGY

By FREDERIC E. CLEMENTS,
Ecological Research, Carnegie Institution of Washington

and VICTOR E. SHELFORD,
Professor of Zoology, University of Illinois

This book opens with a discussion of the scope and development of the concept of "bio-ecology." Succeeding chapters offer a general treatment of the dynamics of the biotic formation, the influence of community on habitat, the interrelations of organisms, and other important phases of the subject, including detailed discussions of the characteristics of certain land, aquatic and marine biomes. "Bio-Ecology" discusses community processes, concepts and nomenclature in such a way as to be of value to either the zoologist or the botanist.

"It is a very timely and splendid synthesis presented by outstanding men. The organization, selection of material, and skill in presenting needed studies makes this a contribution of unusual value to all biologists. I was also glad to find that the authors included man and his cultural effects in the fabric of their weaving."

—PROFESSOR HILDA F. ROSENE, *University of Texas*

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geologists have made concerning conditions deep in the interior of the earth are based on studies of earthquake waves. The fact that certain waves travel faster under the Pacific Ocean than under a continent, for example, has been interpreted to indicate differences in rock structure under oceans and continents. With a new concept of quake-waves, however, many of these conclusions may have to be reexamined.

PAPERS READ BEFORE THE AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

AT the Chicago meeting of the American Academy of Ophthalmology and Otolaryngology held on October 9, 10 and 11 the rare case of a patient whose eyesight was affected by a waterlogged condition of his cornea, relieved by a draining operation, was reported by Drs. R. O. Rychener, of Memphis, and D. B. Kirby, of New York. The cornea is the transparent tissue in front of the eye through which we see. Sometimes it is pushed forward into a cone shape instead of its usual flattened curve under the eyelids. The condition is caused by abnormal stretching of and high pressure within the eye. Vision in such cases is usually very poor. In this case of waterlogging the inside of the cornea was stretched so that the water fluid within the eye worked its way into the layers of the cornea, causing a diffuse cloudiness. By cutting the cornea and draining off some of the excess fluid, thus reducing the pressure, the condition was relieved and the patient had better vision than before the waterlogging complication set in. Only eight other cases of this condition have been reported in medical literature.

THAT diabetic patients whose vision has been impaired by bleeding into the retina of the eye have been helped by large doses of vitamins B and C, was reported by Dr. Jonas S. Friedenwald, of the Johns Hopkins University and Hospital. In these patients the tiny veins and arteries of the retina have very fragile walls and consequently bleed easily. Ordinarily, vitamin C, the scurvy-preventing vitamin of citrus fruits and tomatoes, makes these fragile blood vessel walls sturdier, thus controlling the bleeding tendency. Tendency to bleeding from tiny blood vessels because of deficiency of vitamin C is one characteristic of scurvy itself. Diabetic patients, however, apparently do not always utilize vitamin C normally, so even when given large doses of it, their eye condition does not improve. But when vitamin B, the vitamin found abundantly in yeast and liver, is given with vitamin C, the resistance of the small blood vessels in the eyes of diabetics is restored to normal. Dr. Friedenwald reported "marked improvement" in the eye condition of a small group of diabetic patients who were given the double vitamin treatment. Vitamin B is made up of a number of different vitamins which scientists have recently been separating. Which part of the B complex is responsible for the improvement in the eye condition is being investigated.

VITAMINS, or at least a diet with plenty of vitamins to build up the patient's general health, are a necessary eyesight-saving addition to treatment of syphilis of the brain and nervous system, it appears from the report of Dr. William M. Muncy, of Providence, R. I. High degree of artificial fever plus powerful arsenical drugs are used in treating this kind of syphilis, but the combined treatment was found to cause inflammation of the optic nerve in a number of patients who had no previous eye trouble. Vitamin deficiency was believed responsible. Dietary building-up restored to normal the vision of a number of these patients, after which they were able to stand repeated doses of the necessary arsenical treatment for the syphilitic condition without further symptoms of visual disorder.

Two surgical hole-drilling operations, one of them brand-new, for relief of deafness were reported by Dr. O. Jason Dixon, of Kansas City. The new operation for relief of deafness due to abnormal inward pressure of the ear-drum on the chain of tiny bones in the middle ear. To relieve this pressure, Dr. Dixon makes a hole behind the ear through the mastoid, connecting with the ear-drum from behind. The hole is lined with grafted skin and remains permanently open. Dr. Dixon reported that several patients who had this operation showed considerable improvement of hearing. The other operation for deafness discussed was described by Dr. Edward H. Campbell of Philadelphia. It is applicable only to one type of chronic progressive deafness, characterized by a roaring in the ears. In this operation a hole is drilled into the outermost semicircular canal back of the ear, making a tiny window into the ear. Successful results depend on the window remaining permanently open. There is a tendency for the surrounding bone to grow rapidly and close the window. The operation can not be performed if the patient is extremely deaf, or if he can not hear through the bones of the skull, or if he is dizzy or has other signs of imperfect balancing mechanism.

A NEW kind of sinusitis was reported by Lieutenant Colonel J. E. Ash, curator of the Army Medical Museum in Washington. The condition may feel like the same sinus trouble to the patient, but Colonel Ash discovered that the lining of the sinus in one case showed a type of inflammation like that seen in chronic bladder inflammation. This, apparently, is the first time the condition has been reported. Sinus disease is due either to germs, to allergy like hay-fever or to a combination of the two.

THE recently discovered danger of serious lung trouble from nose drops can be avoided if the drops are made with vegetable oils instead of mineral oils, according to Dr. Frank J. Novak, Jr., of Chicago. The danger arises when the nose drops or spray accidentally get into the bronchial tubes, which is especially likely to happen in babies and small children. Vegetable oils, unlike mineral oils, can be absorbed by the body tissues and disposed of without harm, whereas non-absorbable mineral oils accumulate and sometimes cause damage.

A RARE kind of eye trouble, in which the eye protrudes from its socket and beats or throbs in time with the heart beat, was reported by Drs. S. J. Meyer and H. Saul Sug

Chicago. Skull fractures from automobile accident juries or other hard blows on the temple may cause the ndition, but it is most often due to rupture of the rotid artery, the big artery running up the side of the ck, at the place where it passes through the large venous annel behind the eye. Besides the severe deformity of e eye, the patient hears the disagreeable noise of the ood rushing from the artery into the vein. The physician n hear this by listening through his stethoscope applied the temple, and a whirring sensation is felt through e eyelid. For relief of the condition it may be necessary tie the internal carotid artery.

WARNING that glaucoma with loss of vision may follow e use of large doses of x-rays or radium in treatment cancer of the cheek or tumors of the eye was sounded Dr. Louis Bothman, of Chicago. In glaucoma the eye rdens because of changes that interfere with the normal ape of fluid from the eye. The condition is fortunately rare complication of the life-saving cancer treatment d can be guarded against in most cases by careful reening of the eye against the rays.

DR. WILLIAM T. DAVIS, of Washington, reported that ildren with the kind of squint in which one eye turns may be helped to overcome the condition by careful ining plus the use of strong-lensed eye glasses. These ildren, Dr. Davis said, should be trained to use the uinting eye by covering up the good one. Such children uint when they see sharply, he explained, but the eyes come straight when the vision is blurred, either by strong ses or by training. When the child learns to relax the uscles, glasses may be discarded. This type of squint is tirely different from that arising from muscular weakss or paralysis, which may require both glasses and eration for correction.

ITEMS

A MAJOR epidemic of influenza is predicted for Februy, 1941, with a "Phase 2 outbreak of some severity" ly to occur in February, 1940. The two-phase theory influenza occurrence on which these predictions are ed has been developed by an English physician, Dr. J. D. Webster. It is brought to the attention of American ysicians and health authorities through an editorial in *Journal* of the American Medical Association. Analyzg 'flu epidemic history for the past 49 years, Dr. Webster ds that Phase 1, accounting for influenza outbreaks ery 33 weeks, is the major phase in the influenza cycle. ase 2, the intermediate, covers outbreaks occurring out 16 weeks after Phase 1. This phase has led to a mber of serious outbreaks such as those in Februaryarch, 1924, January-March, 1932, and the first and third rld-wide epidemics of 1918–1919.

VERY great solar activity is now speckling the sun's ce, it is shown on photographic plates taken at the U. S. aval Observatory. The rise in solar activity coincides th increase in magnetic disturbance which is forecast the Department of Terrestrial Magnetism of the Cargie Institution of Washington. On September 29, the S. Naval Observatory photographed 273 spots on the sun's disk. On the next day the number was substantially the same.

A NEW water-repelling chemical which becomes part of the fiber on which it is applied and which can not be removed by any known solvent was announced at the meeting in Boston of the American Association of Textile Chemists and Colorists. The new material, a long-chain quarternary ammonium compound, known as Zelan, gives a permanent water-repellent finish to clothing which laundering and dry cleaning will not remove. Use of the chemical for coating the clothing of armies is seen as one potential use, for the clothing will not become heavy with rain or perspiration. Yet at the same time the chemical does not close the pores of the clothing and allows the evaporation of perspiration which helps keep the body cool. George A. Slowinske, du Pont chemist, said that for flags, pennants and sailcloth the chemical was already showing excellent service. There is no need to dry out the sails to prevent mildew (the time-honored chore of yachtsmen).

AT thirty-eight miles above the earth's surface the temperature is 100 degrees Centigrade, the boiling point of water, Dr. Fred L. Whipple, astronomer of Harvard University, told the meeting of the International Union of Geodesy and Geophysics. Dr. Whipple's discovery was accomplished with a new type of "meteor speedometer" which uses the appearance of shooting star tracks in the sky to tell temperatures in the stratosphere far beyond the reach of man. With his new apparatus Dr. Whipple obtains very accurate measurements of the height, brightness, velocity and deceleration of meteors which flash briefly in the area about 30 to 60 miles above the earth. At heights of 70 miles above the earth the temperature is found to be 20 degrees Centigrade, ordinary room temperature. The basic principle of Dr. Whipple's apparatus is to revolve a fan blade in front of a telescope-camera lens in such a way that if a meteor flashes down across the field of view, its fiery path is broken at measured intervals. This gives an indication of speed and deceleration. There is one such thermometer at Harvard Observatory in Cambridge, while the other is at Harvard's Oak Ridge station, 24 miles away.

BEAMS of piercing neutron particles are now being produced at the department of physics at Cornell University in an experimental advance which will be of great aid to the study of the transmutation of matter, artificial disintegration, etc. Professor R. F. Bacher, of Cornell, and Dr. D. C. Swanson, now at the University of Florida, report in *The Physical Review* that by placing a thick wall of water around a source of neutrons and then putting a "hole" through the water by means of a tube they have achieved a distinct collimation of their neutrons into a beam. Neutrons, because they lack electrical charge, easily penetrate into any atoms with which they come in contact. Previous attempts to produce a beam of them have only been partially successful. And yet such beams have been greatly needed to improve the geometry of many nuclear experiments in which scattering occurs, and cross sections of atoms for neutrons of different energies can be determined.

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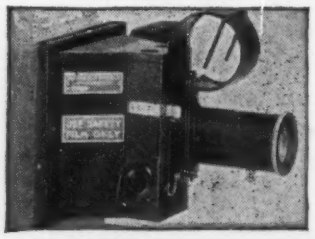

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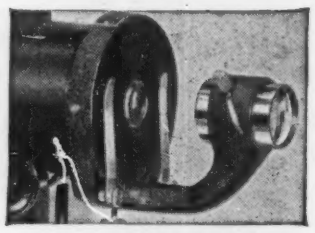

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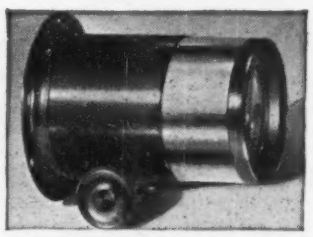

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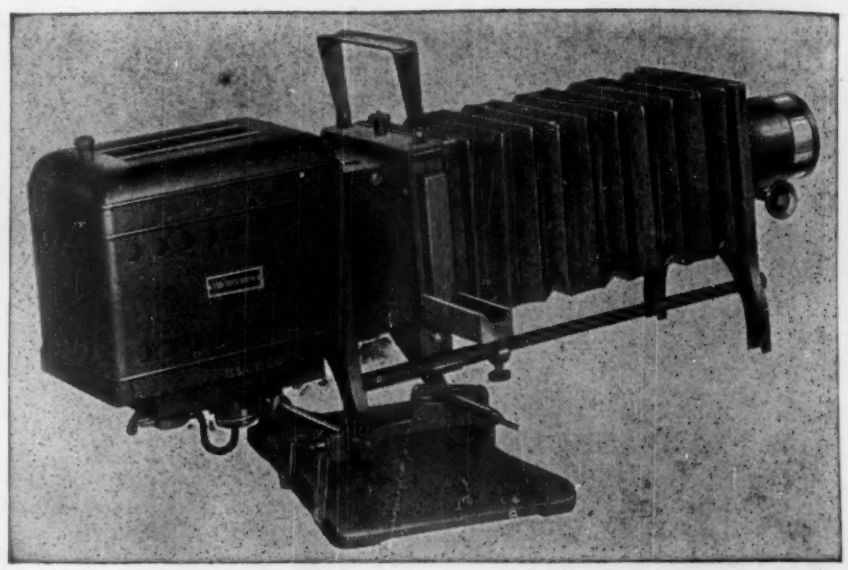

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SCIENCE NEWS

Science Service, Washington, D. C.

BLIND LANDING FOR AIRPLANES

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EXTREMELY difficult is the decision facing the committee of the National Academy of Sciences assigned to select a standard American system of blind landing for airplanes. In the interests of economy, efficiency and national defense, President Roosevelt has asked the academy for this decision.

This committee, as yet unselected, must choose from at least seven different blind landing systems which have been developed since Major James H. Doolittle, ten years ago, made the first blind instrument landing at Mitchell Field, L. I. The seven systems which have gone beyond the paper stage of development into actual airport installations include those of Air Track, Army, Bendix, I.T.D., Lorentz, M.I.T.-Metcalf and the Navy. The committee will examine impartially the claims, merits and tried performance of these systems and others and recommend accordingly. The fundamental question is whether it is wise now, after only the relative short time of ten years of development, to standardize on any one blind landing system.

The first of serious attempts to land an airplane with instrumental aid alone was that of the National Bureau of Standards in Washington in 1928. This method used a radio range beacon signal to mark the line of the runway and a marker radio beacon at the end of the field for longitudinal guidance. It was this system that Lieutenant Doolittle used in making the first successful blind landing in 1929. Later in 1929, at College Park Airport, Md., a glide path was added to the system by radio beams which provided the pilot with a positive and continuous indication of his vertical and lateral position. The marker beacons at the end of the airport gave indication of longitudinal position. The first landing on the complete system was made by M. S. Boggs on September 5, 1931. This was followed early in 1933 by landings at Newark.

Following publication of the Bureau of Standards work, the Lorentz Company in Germany developed a commercial system along similar lines. This system is in operation at several European airports and was tested at Indianapolis in 1937. During 1932 and 1933, the U. S. Army developed its own system of blind landing, which involved the use of a sensitive altimeter to give indication of the height above the ground. This system was quite easy to fly and required only a short pilot-training period, but failed to interest commercial aviation greatly because of lack of a finite course down the runway.

Essentially all the systems, with the exception of the Dingle system backed by the Navy, utilize very short radio waves to obtain sharp directional signals. The Navy in contrast employs very long wave-lengths. Standard practise is to detect with instruments in the plane the line of equal signal intensity between two directional radio beams. If the beams originate on a landing field, the equal-intensity line will furnish the pilot with the line of the runway. In the Army's newer system the direction is determined by direction finders on two radio stations.

COLOR VISION

THE first explanation of the chemistry underlying color vision in an animal was reported at the Lake Placid meeting of the Optical Society of America by Dr. George Wald, of the Harvard University Biological Laboratories. Dr. Wald has isolated and identified three color pigments found in the cones of the chicken eye, the color-seeing receptors. These pigments, he said, probably act as color filters in much the same sort of arrangement used to take color photographs.

The pigments are astacene, which is responsible for the color of boiled lobsters; xanthophyll, the pigment of egg yolk, and a carotene, a pigment giving carrots their characteristic color. The color "film" of the chicken eye, on which the filtered light falls to start the seeing process, contains a violet, light-sensitive pigment which Dr. Wald has named iodopsin. It is the first light-sensitive pigment ever found in the cones of the eye.

Dr. Wald, winner of this year's Eli Lilly prize of the American Chemical Society for his outstanding research on the chemistry of vision, gave his explanation of chickens' color vision during a paper in which he massed experimental evidence to prove that many of the complicated phenomena of seeing, a process involving man's highest mental powers, can be explained on a basis of relatively simple chemical and physical reactions which take place in the eye. More and more, he said, scientists are learning that many of the properties of vision are derived directly from the properties of various substances in the retina of the eye, the photographic plate on which images of the outside world are formed. As an example Dr. Wald reported the direct chemical analysis of retinas which show that rhodopsin, a rose-colored, light-sensitive pigment found in the rods, is manufactured by the body from two different precursors, either retinene or vitamin A.

This discovery has afforded a physico-chemical explanation of varying rates of the adaptation of the eye to darkness, for the synthesis from retinene is much more than that from vitamin A and the speed of the adaptation depends entirely on which precursor is being used. It also explains why a deficiency of vitamin A results in night-blindness, the inability to see in dim light, he reported. Without the vitamin there just isn't enough rhodopsin being formed.

In studies of experimentally induced night-blindness in human subjects, conducted by Dr. Selig Hecht and his colleagues at Columbia University and Dr. Wald, it was found that not only the rods but also the cones of the eye are affected by a faulty diet, a discovery which implies that vitamin A may be the precursor of the light-sensitive material of the cones as well as of rhodopsin.

Dr. Wald has found that visual sensitivity may decrease markedly within 24 hours on a vitamin-deficient diet. It

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ATOMIC ENERGY OF URANIUM UNDER NEUTRON BOMBARDMENT

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FROM eight pounds of uranium enough atomic energy can be released by neutron bombardment to drive a giant ocean liner like the *Queen Mary* across the Atlantic.

This calculation, showing the potency of atomic energy in contrast to fuel oil used by the Atlantic liners, can be made on the basis of new experiments just reported to the American Physical Society by Dr. Malcolm C. Henderson, of Princeton University, who has measured the heating effect of the atomic energy in uranium splitting by neutrons.

Dr. Henderson exposed 13 grams of metallic uranium to intense beams of slow neutrons generated at the great cyclotron of the University of California. Inside the uranium sample he placed a resistance thermocouple and measured the rise in temperature. From this he found that each uranium atom being split liberates 175,000,000 electron volts of energy.

From this figure calculations show that, if uranium energy could be applied:

1. Eight pounds of uranium would drive the *Queen Mary* across the Atlantic, as a substitute for the 6,300 tons of fuel oil her bunkers now carry.

2. Splitting 155,000,000,000 uranium atoms would warm one gram of water one degree Centigrade.

3. Only a little over a half-pound of uranium would warm a ton of water to 3,860,000 degrees Centigrade; or convert 386,000 tons of ice water into boiling water.

GIANT PROPELLERS

(*Copyright, 1939, by Science Service*)

THE world's largest propellers for airplanes, designed for the super-giants of the air, are now being made at the Riverdale, Md., laboratories of the Engineering and Research Corporation. Unique are these newest blades, for they are of composite structure and contain light wood, hard wood, plastics and metal. Fed E. Weick, chief engineer of the Engineering and Research Corporation, described the new propellers at the meeting of the Washington Section of the Society of Automotive Engineers.

The largest blades yet made by the composite process measure 17.5 feet from tip to tip, but engineers see no size limitation to the method. The large propellers of the Pan American "clippers," now flying the Atlantic, measure 14 feet. The new composite blades are easily produced, are 33 per cent. lighter than comparable metal propellers, are strong and have low cost. The blades consist of a core of laminated light wood which merges into a root of impregnated and compressed hard wood. This, in turn, is threaded into a controllable pitch propeller hub. The whole blade is covered with a heavy coating of reenforced plastic and the leading edge is protected by a flush strip of metal.

As aeronautical engineers have sought to get greater and greater power for airplanes they have been forced to go to larger propellers, for the greater the power the greater must be propeller diameter to retain equal efficiencies. While much progress has been made in speeding up engines so that they turn over more rapidly, there is a limit in this direction, for the propeller tip must not move at speeds comparable with those of sound, about 740 miles per hour. Interest in lighter propellers comes because as the size of a propeller increases its weight goes up faster in proportion than does the power it will deliver. This gives a light but strong propeller a sizable edge in utility.

THE INVENTION OF A THERMAL PUMP

(*Copyright, 1939, by Science Service*)

AN ingenious "pump" that can compress gases, create vacuums or transfer heat against its normal direction of flow and thus be useful as a refrigerating mechanism has been invented by the president of the Carnegie Institution of Washington, Dr. Vannevar Bush. A patent just issued (No. 2,175,376) describes the new apparatus which Dr. Bush developed while at the Massachusetts Institute of Technology in collaboration with Edwin L. Rose, chief engineer of the Waterbury Tool Company.

In contrast to other devices doing a similar job, Dr. Bush's machine uses not mechanical energy but heat energy to accomplish its "pumping" of either gas or heat. Patent rights have been assigned to the Research Corporation, non-profit corporation of New York City, founded to control the proper exploitation of important scientific discoveries.

When used to compress a gas, or transfer heat from a lower to a higher temperature, a substantially constant volume of gas is alternately heated and cooled, thereby alternately raising and lowering its pressure, says the patent.

"In the case of a compressor," continues the patent, "these fluctuations in pressure are utilized to effect the transfer of gas between two regions of different pressure by admitting gas to the system from a region of low pressure when the pressure is low and ejecting gas from the system to a region of high pressure when the pressure is high. In the case of the thermal pump, the fluctuations in pressure are utilized to effect corresponding fluctuations in pressure in another but communicating body of gas from which heat is ejected to a region of high thermal potential when the pressure is raised and which is caused to absorb heat from a region of low thermal potential when the pressure is lowered."

Heating of the working substance (a gas) is accomplished by a small burning flame. The system contains a blower to make the working substance flow in the proper directions at the proper times, but the patent emphasizes that this blower is used only to control the thermal cycle and does not do mechanical work in compression.—ROBERT D. POTTER.

FOLSOM MAN

(*Copyright, 1939, by Science Service*)

TWO decorated beads worn by Folsom Man or his wife are new evidence that America was no savage, uncouth place at the end of the Ice Age.

The bone "costume jewelry" is among discoveries

orted by Dr. Frank H. H. Roberts, Jr., of the Bureau of merican Ethnology, who has returned from excavating the earliest American home yet found—a camp site of olsom hunters near Fort Collins, Colo.

It is becoming clear, according to Dr. Roberts, that merica's earliest known culture must have compared vorably with Europe's Stone Age cave society existing the same time. Geologists who have studied Folsom an's only known home pronounce the relics to be as d as the last glacial period in America, usually timed om 12,000 to 25,000 years ago.

Folsom hunters, so-called because their favorite and eculiar stone dart-points first came to light at Folsom, . Mex., followed big game such as mammoth and bison. t far from spending all their time roving like savages d eating just to live, these early pioneers had home and mmunity life. They enjoyed artistic decorations as own by the beads, and also by the red and yellow paint ound by Dr. Roberts.

They made the beads of long bones of some small ani-al, smoothing the rough edges and marking simple pat-rned lines on the surface. Their specialty in stone was e grooved Folsom point, beautifully made, but Dr. berts has unearthed a variety of tools and weapons hich they contrived, including some new knives and rapers first discovered this year.—EMILY C. DAVIS.

THE TREATMENT OF DETACHED RETINA

ELECTRICAL spot-welding in the eye for restoring sight patients threatened with blindness due to a detached tina was stated by Dr. Samuel J. Meyer, of Chicago, at e Philadelphia meeting of the American College of rgeons, to be effective in a number of cases.

The retina is the light-sensitive part of the eye which ansmits images to the brain through the optic nerve. t may be compared to the photographic film or plate a camera. It depends for its nourishment on tissue lled the choroid. When, because of injury or disease, becomes detached from the choroid, it can not function roperly and the patient feels as if a curtain were falling er part of his eyes. If not treated, the retina as a rule ill eventually all peel off the choroid, like wallpaper f a wall, and total blindness results. Modern eye sur-ons treat this condition by a kind of electrical spot-elding. Tiny needles carrying an electric current are pplied to the choroid without puncturing it. The electric auterization produces an adhesive inflammation between e choroid and the retina, causing the retina to become eattached.

This method is only 11 years old, but increasingly good esults are obtained. More than one out of three patients perated on at the Illinois Eye and Ear Infirmary since 934 had reattached retinas with vision ranging from ormal to one tenth normal.

ITEMS

THE skull of an evolutionary link between reptiles and ammals, that lived in South Africa many millions of ears ago, has been studied in detail at the Walker Mu-eum of the University of Chicago by the Reverend Harold W. Rigney, missionary-scientist now stationed at Accra, Gold Coast, West Africa. The animal, known to geologists as *Galesaurus planiceps*, belonged to the extinct order called cynodonts—the name means "dog-tooth." Although unquestionably reptiles, cynodonts resemble primitive mammals in some details of skull structure.

THE strangest fluid in the world might well be the title for liquid helium, which turns from a gas to a liquid only at the temperature of a few degrees above absolute zero. Dr. J. O. Wilhelm, low temperature expert of the University of Toronto, says that liquid helium, for equal volumes, weighs only one seventh as much as water. It has the ability to conduct heat as well as metallic copper, and it is so lacking in viscosity that it can be regarded as a gas.

AMERICAN corn fields potentially can produce fibers with wool-like properties, it appears from research reported by L. C. Swallen, chemist of the Corn Products Refining Co., at Argo, Ill. From a bushel of corn a pound of zein, a by-product of corn processing, can be obtained. Zein is a protein with uses, in many cases, like those of casein derived from cow's milk. It can be made into plastics, into water-proof wrappers, quick-drying printing inks and into films and fibers.

BOTANISTS and biochemists of the University of California have discovered in the juice of milkweed an active substance that can tenderize meat as successfully as can papain, extracted from the tropical plants, papaya, now used on a large scale for the purpose. The quantity of the new-found substance is small, but it is believed that large-scale and intensive cultivation of the plant might make its production profitable. At present, papaya imports amount to half a million pounds a year, costing several million dollars. The active principle of the milkweed has been named asclepain, from the botanical name of the plant, Asclepias, by analogy with the formation of the word papain from the plant name Papaya.

A NEW and simplified electron microscope, suitable for use in research institutions, was perfected in Germany by the great electrical firm Siemens and Halske A. G. shortly before the outbreak of war. Earlier models of this instrument, which uses streams of electrons in a vacuum tube to make visible minute structures and details not detectable by any microscope using beams of light, required the services of technicians specially trained in the handling of high vacuum and electrical instruments, which made operation too expensive for most research purposes. The new instrument obviates the necessity for these extra attendants.

THAT ultra-violet radiation, deadly to cells if administered in certain doses, proves a stimulant to growth in the same kind of cells if given in doses of two thirds the lethal magnitude, has been demonstrated in experiments at the Smithsonian Institution, performed by Dr. Florence E. Meier. Dr. Meier used cultures of the one-celled alga or water plant, *Stichococcus bacillaris*. Some were rayed, others were left unrayed, as controls. The cultures that were given the stimulative raying not only showed the response in their own generation but passed on the habit of rapid cell-multiplication to their descendants for many generations.

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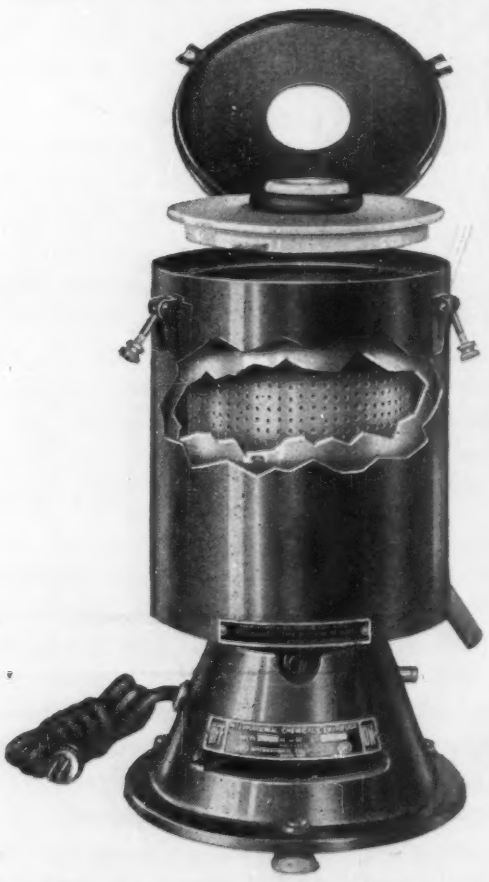

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SCIENCE NEWS

Science Service, Washington, D. C.

THE GIACOBINI-ZINNER COMET

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THE Giacobini-Zinner comet, periodic comet absent from the region of the sun and earth for 6.6 years, has again been sighted and the amazing meteor shower which Europe saw in 1933 may still have a chance to be repeated. Dr. George Van Biesbroeck, of the Yerkes Observatory of the University of Chicago, has discovered the comet whose crossing of the earth's orbit in 1933 caused the memorable meteor shower.

Astronomers had calculated that in 1933 the earth passed through the region of space occupied 80 days earlier by the Giacobini-Zinner comet. This region was still "dusty" from specks of matter carried along in the same orbit as the comet. As these specks struck the earth's atmosphere they flashed as "shooting stars." Astronomers had thought possibly that on October 9, 1939, this same happening might occur again.

The rediscovery of the Giacobini-Zinner comet occurred at a position almost precisely that predicted by astronomers. This means that its orbit has been disturbed only slightly, if at all, during its absence of 6.6 years from the region of the earth. Preliminary calculations prior to the comet's discovery suggested that the earth should precede the comet by some 136 days, to the point in space where their orbits crossed. Astronomers still hope for a meteor shower in 1940, when the Giocobini-Zinner comet passes ahead of the earth by 229 days.

The position of the Giacobini-Zinner comet, at the time of its discovery by Dr. Van Biesbroeck on October 15, was at right ascension 16 hours, 21 minutes and 7 seconds, while its declination was plus one degree, 18 minutes and 53 seconds.

While its magnitude is so faint (15th) that only telescopes can see it, astronomers will be able to detect it about half way up to the zenith in the northwestern sky shortly after sunset. It is near the center of the triangle formed by the widely separated bright stars, Vega, Arcturus and Antares.

THE EFFECT OF SUB-OPTIMAL DIET

AT the Pittsburgh meeting of the American Public Health Association Drs. Henry Borsook, professor of biochemistry at the California Institute of Technology, and Wilton L. Halverson, health officer of Pasadena, Calif., reported a survey showing that families on sub-optimal diets—less than the best—were no less healthy than families having adequate food intakes.

"Families on sub-optimal diets," they declared, "were not found by the measures employed to have a greater degree of ill health than those having adequate food intake. A study of a larger number of families over a period of years utilizing more exact measures of ill health will be necessary to show the alleged harmful effects of a sub-optimal diet."

The diets of 50 families, 151 adults and 72 children, in economic levels from relief to those with annual incomes of $3,000 were studied. Clinical examinations were made of 80 persons in 25 of these families, including height, weight, evidence of rickets, heart, lungs, skin texture, hair texture, teeth and blood tests for anemia. No correlation between defects and dietary insufficiencies were found.

These families spent from $0.89 to $4.80 per person per week for food. Practically all families spending as much as $2.08 per person per week were eating adequately, and so were some spending as little as $1.50 per person per week.

Only about half the families got enough to eat as measured in calories. They were low on protein but got enough fat and starches and sugars. As to the important minerals and vitamins: They all got enough iron, according to present nutritional standards, but about half of them did not get enough calcium or lime. Almost all the families went short on vitamin A rations, only one getting more than the recommended amount. About a third of the families got less than enough vitamin B. All of them, however, received enough vitamin C from their diets.

THE PREVENTION OF INFLUENZA

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LIEUTENANT-COLONEL A. PARKER HITCHENS, M.C., professor of public health at the University of Pennsylvania, speaking at the meeting of the American Public Health Association, called attention to the fact that two weapons, a vaccine and a germ-fighting lamp, are ready for trial in the next great influenza epidemic. Either or both of them may emerge from such a trial as a practical means of preventing influenza. At least three institutions in America and one in England have already vaccinated small groups of people. If these groups come through the next epidemic without having influenza, the value of the vaccines will be shown. The institutions are all guarding their vaccination work, because they are not ready yet to vaccinate the entire population, even in the event of an epidemic. Under such conditions they could not get the accurate information necessary for a real appraisal of the vaccines. But they are ready and waiting for the results with the groups already vaccinated to show whether the entire population of a nation can be protected against influenza.

The influenza-fighting lamp, designed by Professor William F. Wells and Dr. Mildred Weeks Wells, of the University of Pennsylvania, is designed to fight any disease like influenza whose germs travel through the air, by letting down a curtain of ultra-violet rays to keep the germs out of a room and to kill any that may already be in the room. Similar lamps are being used in many operating rooms throughout the country to keep germs out of open wounds.

Schools and hospitals are already, in a few places, using the Wells lamp to protect children from germs of influenza, measles and similar infectious diseases. English, French and Canadian medical authorities, hearing about it at

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recent Congress of Microbiology in New York, are considering use of the lamp in dormitories to protect children, especially where there is crowding due to evacuation of children from London, Paris and other large cities.

THE SUPPLY OF VANADIUM

URAVAN in Colorado, a new city, sounds as if it might be a Soviet settlement in the Urals, but it is instead a glowing achievement of American private enterprise, and a symbol of the reasons why the United States can never again be cut off from a supply of the essential silver-like alloy, vanadium.

Uravan is almost as remote as if it were in the Urals, at that. It is 115 miles from the county seat, Montrose; 60 miles from the nearest railroad, at Placerville. It is just east of the Utah line in southwestern Colorado, as wild and lonely a section as there is in the United States.

A few years ago Uncle Sam ranked a distant last among producers of vanadium, a strategic metal both in war and peace. In 1936 only 63 tons were produced here. By 1938 that production had leaped to 732 tons, an increase of more than 1100 per cent. The United States has in this short time become the producer of a third of the world supply.

This is especially important because, with the exception of Mexico, a minor producer, the centers of vanadium mining were in Northern Rhodesia, Southwest Africa and Peru—all far away.

Vanadium by increasing the toughness and "springiness" of steel has become well-nigh indispensable in the manufacture of autos and other vehicles, besides having many direct uses in war.

The Vanadium Corporation of America, a subsidiary of the Union Carbide and Carbon Corporation, developed the mines and the town. It is said that there is enough ore to keep the plant going for a hundred years.

This is not the first mining in the area. Instead it was the scene of one of the most important and romantic ventures in the history of American mining. Here was found the world's first major supply of radium, only a few years after it was discovered. The Standard Chemical Company and the Flannery interests of Pittsburgh worked thousands of tons of the carnotite ore for a thimbleful of radium. When the women of America gave Madame Curie a gram of radium it came from Colorado. Then the rich deposits of the Belgian Congo were discovered and the American mines became unprofitable. Those carnotites, and the vanadium ores which the radium miners threw over the dump, are among those now being worked at Uravan.

Both radium and uranium are being produced again, but now as by-products of the vanadium production. In 1938 the mines produced 7,811 milligrams of radium, against 3,141 in 1937.

As for vanadium, Colorado produced 1,382,000 pounds of concentrates in 1938. This was more than the whole United States production in 1937, and the total United States production in 1938 was only 1,613,000 pounds. In other words Colorado produced more than 80 per cent.

The company payroll runs about $50,000 to $60,000 a month, there are between 200 and 250 working, and the production is about 250 tons of ore daily. The town is completely company-owned, and such necessities as co are brought in—from its own mines—by the compan Beef and vegetables are raised in the near-by Parad Valley—so called because the Dolores River takes i stubborn way right across the waist of the valley inste of flowing down it as a well-conducted river should—b staples must be trucked in from Montrose or Gra Junction.

ALASKA AND EUROPEAN REFUGEES

(*Copyright, 1939, by Science Service*)

OPENING the door of Alaska to European refugees a United States immigrants, is a proposal now taking a new and favorable angle.

While international conferees have been discussing t fate of several hundred thousand refugees, the Unite States' leading possibility for helping to resettle of the homeless in Alaska needs Congressional actio The Department of the Interior advocates that priva development corporations be permitted to open up su able areas in Alaska, to offer opportunities for selecte refugees and immigrants also from the states.

Since this view was reported, in August, the Departme of the Interior, in cooperation with the State, Commer and Labor Departments, has been putting finishing touch on a bill to provide a practicable way for admitti foreign settlers to Alaska. The favored plan is to pr vide a new quota-exempt class, exempting from quota pr visions Alaska settlers as long as they are engaged in th corporate ventures, in the same way that students a certain other classes are admitted to the United Sta without conforming to quota requirements. The forei settlers would not be permitted to enter the United Stat from Alaska except under quota provisions.

Alaskan industries, according to one advocate of th planned colonization project, are the type to be stimulate by war. Alaska has the only tin resources under Unit States control, and these are not fully developed. W still import 99 per cent. of our tin. Platinum, copper an gold are being produced on a limited scale and there ar unworked deposits of coal, nickel, asbestos and gypsum

Southeastern Alaska's forests offer Sitka spruce lumbe as well as pulpwood sufficient to print one fourth of th news in the United States. Since the United States de pends on foreign supplies, chiefly Canada, Finland an Sweden, for three fourths of its newsprint, the assuranc that Alaska not only can supply timber but has the wate power for running pulp and paper mills is more importa now than it was two months ago.

Fish is always a food product in demand in wartim and Alaska offers fishing opportunities, not so much pe haps in the salmon industry, which is already well d veloped, as in the herring industry. The United State imports almost all of its herring from Scandinavia an Great Britain and the pack of salted and pickeled pro ucts is likely to be diverted toward European needs.

The project for developing Alaska differs from m proposals to aid refugees and others seeking new oppo tunity in that Alaska's possibilities are industrial as w as agricultural. Those favoring planned pioneering

develop Alaskan resources point out, also, that the climate in many regions suitable for industry is no more rigorous than in Washington or in New York, and that a number of the present settlers are of southern European origin.

Individual pioneering in Alaska, or almost anywhere else, is over, it is argued by those who have been investigating Alaska's prospects. The new era of pioneering is seen as necessarily a planned economy, in which industrial development would be balanced and directed toward actual market needs.—EMILY C. DAVIS.

STAINLESS STEEL

(*Copyright, 1939, by Science Service*)

A NEW way to prevent corrosion of stainless steel in salt water, long an Achilles heel of an otherwise excellent structural material, was described at the opening meeting of the American Institute of Mining and Metallurgical Engineers at Chicago as part of the giant National Metals Congress now in session.

Dr. H. H. Uhlig, research associate of the Massachusetts Institute of Technology, described long-continued research to seek the causes and the prevention of the corrosion of stainless steel in salt water. It has been this handicap which has, in the past, led the U. S. Navy to regard, with only mild approval, the use of stainless steel on naval vessels where it is subjected to sea water.

Dr. Uhlig's research, supported by grants from the Chemical Foundation, shows that if stainless steels are exposed to air for some hours, or if they receive treatment by an oxidizing solution directly after the pickling operation, they will be corrosion-resistant in salt water.

Dr. Uhlig has worked in a cooperative research at the Massachusetts Institute of Technology, which has resulted in a number of important patents on ways of increasing the ability of stainless steels to resist corrosion. Those who have taken part in this research include John C. Wulff, Albert L. Kaye, and Professor Robert S. Williams.

Among the discoveries is the use of small amounts of the chemical that produces smoke for warfare, titanium tetrachloride, to give stainless steel a lustrous and extra smooth new surface which is especially resistant to pit corrosion. This surface has such luster that it can be fabricated into beautiful jewelry, rivaling precious metals in appearance.

They have also found that minute amounts of silver, as little as .42 per cent., can cut down the salt water corrosion of stainless steels more than 80 per cent. The silver, moreover, greatly improves the rolling and machining properties of the metal.

ITEMS

RAINFALL for the month of October thus far ranges from half normal or less in the western Prairie region, through one fourth to one third in the Ohio valley, 10 per cent. normal in Tennessee, down to almost zero in parts of the Gulf states and in western Kansas. This, following an abnormally dry September, creates a serious situation.

DIPHTHERIA threatens to become wide-spread and severe in the South and there is no assurance that it will not do the same in the North. Diphtheria germs found in different parts of the country vary considerably in their disease-causing ability, according to a report made by Dr. Martin Frobisher, of The Johns Hopkins University, Baltimore, to members of the American Public Health Association. In the South, particularly in Virginia and Alabama, a more virulent, dangerous kind of germ has been prevalent within the last two years. During this same period there have been more cases of diphtheria. In the North, where diphtheria cases have declined enormously in the past ten years, a different type of germ is found. These facts suggest that health authorities, by studying the kind of germs in their locality, can predict the coming of an epidemic or of more severe cases of diphtheria. Not enough information is available yet, Dr. Frobisher said, to be sure whether such predictions can be made accurately, but he stressed the need for further studies along these lines.

COMPLETION of a breeding program to produce chrysanthemums as brilliant and showy as most of the greenhouse varieties now in use, but able to survive winters as far north as Michigan and Wyoming, has been announced recently by the U. S. Department of Agriculture. The new chrysanthemum varieties, of which there are a dozen, all bearing Indian names, were developed by F. L. Mulford, who recently retired, after long service in the Bureau of Plant Industry. Mr. Mulford let nature do the selecting for hardiness and earliness. Late bloomers he ruthlessly discarded, and he let winter cold kill off non-hardy seedlings. The Department of Agriculture does not have any plants for free distribution, though it does have a free bulletin (Circular 528) describing them. The plants have been put into mass propagation by several leading commercial firms.

EXPERIMENTS concluded at the Massachusetts Institute of Technology show that old-fashioned molasses is about the best food known for treating nutritional anemia, the kind of anemia due to improper diet. Spinach as a source of iron was thoroughly debunked by the research conducted by Dr. Robert A. Harris, Dr. John W. M. Bunker and L. Malcolm Mosher. Whereas molasses has 6.1 parts of usable iron per 100,000 parts by weight, spinach has only 0.5. Beef liver has 5.6; oatmeal, 4.6; apricots, eggs and raisins following in that order. Usable iron was computed, not total content, for only that iron which the body can use to manufacture hemoglobin is valuable. Both chemical and biological tests on rats were used. It is also reported that recent medical studies indicate that nutritional anemia is far more prevalent than had been suspected. More than 40 per cent. of infants have it and the figure for adult women is as high as 70 per cent. It is also fairly wide-spread among growing children.

THERE are autumnal migrations of bats as well as of birds. Much less is known, however, about bat migrations. Some of them appear to be for considerable distances, but many species only travel to some cave especially well adapted for comfortable and secure hibernation, which is not used as summer sleeping quarters. Other bat species do not migrate at all, but find their summer roosts good enough for the long winter sleep as well. No bats, however, remain active throughout the cold season as do some species of birds.

NEW BOOK AND INSTRUMENT CATALOGUES

AMERICAN INSTRUMENT COMPANY, Silver Spring, Maryland. *New Catalog of Instruments for Testing Cement, Soils and Petroleum; SC15.* Pp. 164.

BALDWIN-SOUTHWARK CORPORATION, Philadelphia. *Baldwin-Southwark; Third Quarter, 1939; Vol. 3, No. 3 & 4.* Pp. 25. Illustrated.

BARTH, JOHANN AMBROSIUS, Leipzig. *Chirurgie.* Pp. 32. Illustrated; *Das Ärztliche Gutachten im Versicherungswesen.* Pp. 8. Illustrated; *Dermatologie und ihre Grenzgebiete.* Pp. 16.

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COLEMAN ELECTRIC COMPANY, INCORPORATED, Maywood, Illinois. *A New Instrument; The Coleman Regional Spectrophotometer.* Illustrated.

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LEITZ, E., INCORPORATED, New York. *Leica Photography; September, 1939, Vol. VIII, No. IX.* Pp. 28. Illustrated. Price $0.10.

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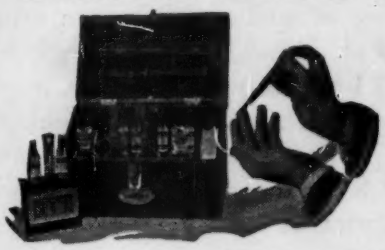

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SCIENCE NEWS

Science Service, Washington, D. C.

ADVENTURES IN SCIENCE[1]

Announcer: "Adventures in Science" . . . with Watson Davis, director of Science Service. What's new in science to-day, Mr. Davis?

Mr. Davis: The National Academy of Sciences is meeting here in Providence, R. I., to-day, and I want to tell about some of the important scientific discoveries that were announced before it this morning and afternoon.

Announcer: What were some of them, Mr. Davis?

Mr. Davis: I was very much interested in the paper by Dr. Hudson Hoagland, Clark University physiologist, who has found that breathing of your brain cells sets the pace for your mental activity.

New understanding of paresis, or brain syphilis, one of mankind's major mental diseases, may result from this discovery.

Electric waves from the brain itself signal to scientists the nature of this chemical control.

Each cell in your brain, as a by-product of respiration, builds up electric potential. The cell walls have electric resistance. The electricity is discharged whenever the respiration process builds up potential and loads the capacities of the cell walls to their critical firing point. This electrical discharge forms the brain waves—electrical signals direct from the brain. Thus brain cell respiration creates the brain waves.

Thanks to brain waves, too, science's inquiring finger can now point more accurately to the parts of the cortex of the brain that discriminate sensation, or feeling, in various parts of the body. This is an achievement reported by Dr. J. G. Dusser de Barenne, of Yale University.

The electrical brain waves, generated in the brain itself, can be made to signal the location and the extent of the area of the sensory cortex.

The shape of man's body hints how he may die. The shape and proportions of a man, still in good health and a long way from his funeral, give fairly definite indication of how and when he may be expected to die. This is a find by Professor Raymond Pearl and Dr. W. Edwin Moffett, of the Johns Hopkins University.

Professor Pearl made a study of the histories of 2,332 men, all dead, representing the longest-lived and shortest-lived groups out of a much larger number. Information about their bodily constitution had been placed on file years before, when they were all in good health, with no indications of onset of the various diseases that finally killed them. He divided them into two classifications, long-lived and short-lived.

He found short-lived men who died of heart and kidney ailments were bigger around the body, in both chest and abdominal girth, than long-lived men who died of the same groups of diseases.

This condition was reversed in the case of men who later died of cancer and pneumonia: the skinny men were shorter lived than the stouter type.

[1] Radio program presented on Monday, October 23, under the auspices of Science Service, over the Columbia Broadcasting System.

In those eventually dying from cancer and from diabetes the average body weight was also greater in the short-lived than in the long-lived group. The difference here, however, was too small to justify any very definite conclusions.

Height apparently had nothing to do with length of life. Talls and shorts were scattered at random through all the disease groups, among both long-lived and short-lived.

Pulse rate was more rapid among all groups of the short-lived than it was among the long-lived groups.

Production of atomic projectiles of more than 100,000,000 electron-volts energy was forecast when Professor E. O. Lawrence, of the University of California, inventor of the atom-smashing cyclotron, told the academicians that building of a 120-inch, 2,000-ton cyclotron, double the size of his world's largest, is entirely feasible.

His new 60-inch cyclotron, weighing over 220 tons, has just gone into service. Gratifying results cause Professor Lawrence to look forward to a still more powerful machine for impressing large energies upon tiny fragments of matter.

By bombarding bismuth and lead with 32,000,000-volt helium ions, Professor Lawrence has obtained large yields of new radioactive substances that produce alpha particles which are also emitted from natural radium.

These, or other cyclotron radiations, promise to prove useful in treatment of cancer and for other medical purposes.

The National Academy of Sciences is the leading scientific body of the nation before which are read and discussed scientific reports, as is being done here at Brown University this week. But that is only one of its functions. It is Uncle Sam's scientific consultant as well. As a body it is adviser to the United States Government on things scientific. Quietly, without much fanfare of publicity, the academicians give freely of their expert knowledge and opinion when the need arises. As senior scientific body of the nation the academy also cooperates closely with hundreds of other scientific groups in solving problems and conducting research of immense importance to all of us. Our Adventures in Science guest to-day is the president of the National Academy of Sciences, Dr. Frank B. Jewett. He is one of our leading engineers, president of that fruitful cradle of new industries, the Bell Telephone Laboratories. Dr. Jewett will tell us how science could be mobilized, and, indeed, is being mobilized, in the United States.

In time of war, Dr. Jewett, the mobilization of science would be as necessary as the mobilization of the Army and Navy.

Dr. Jewett: Yes, it is. War always brings emergency problems for the scientists of a nation. But we ought not to let this overshadow the fact that in a country like the United States science is always mobilized to a considerable extent. Our government always has problems—for example, those of public health, which deserve continuous study and which in wartime may be accentuated. Likewise, the Army and Navy have innumerable problems of so broad a character that they extend beyond the scope

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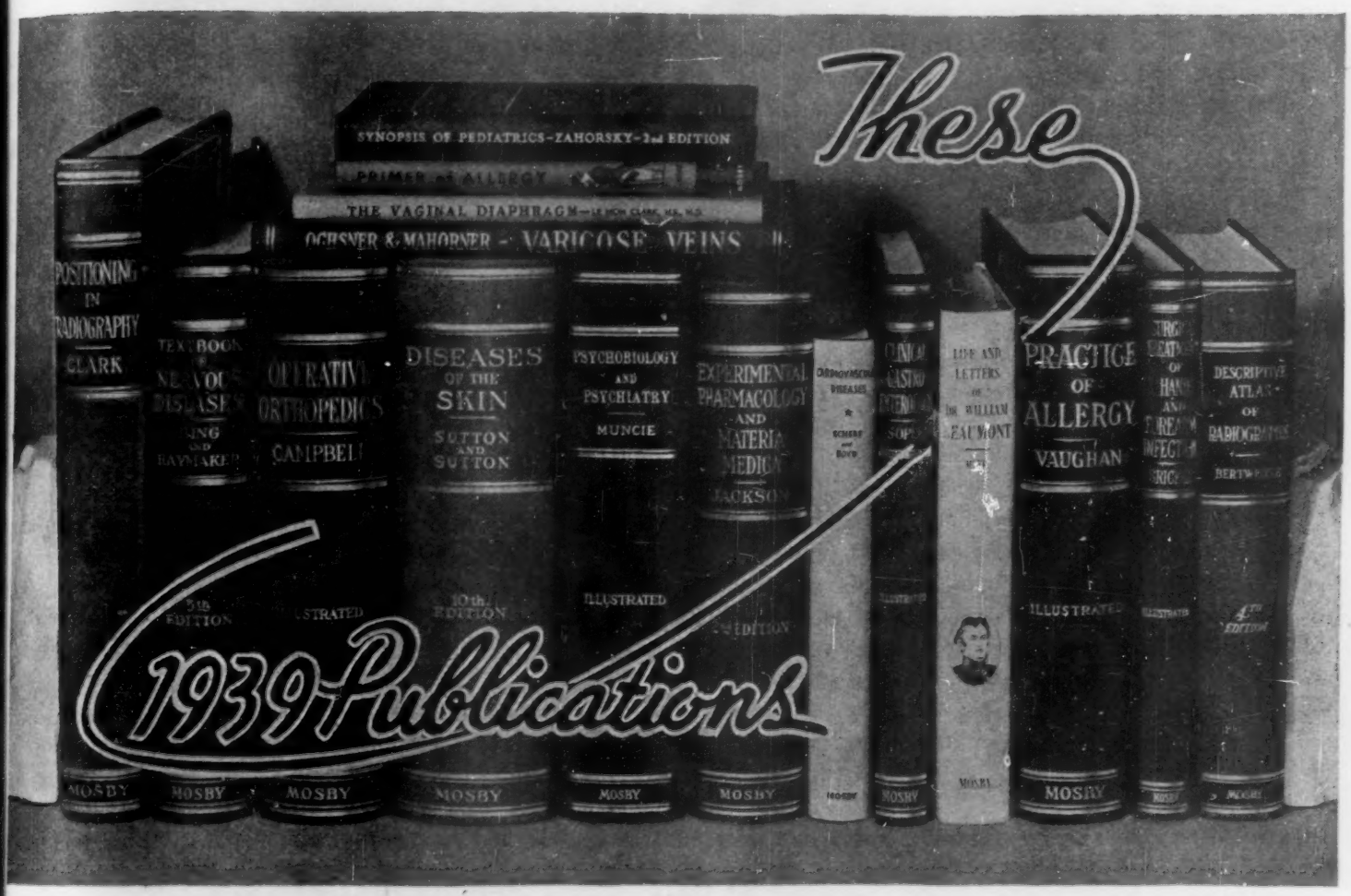

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the organized forces and their specialized laboratories, and in the solution of which they ask the assistance of the nation's outstanding specialists. In the handling of such long-range problems it is apparent that we must take time by the forelock; adequate preparedness presupposes more or less continuous focusing of the nation's best scientific talent upon these problems of defense. Such problems arise not only in the newer developments, such as flying, but are equally numerous in the older services.

Mr. Davis: As I understand it, Dr. Jewett, the National Academy of Sciences, which serves the government in peace time, would have responsibilities placed upon it in time of war.

Dr. Jewett: That is correct, Mr. Davis. The National Academy of Sciences had its inception during the Civil War. It was created by an Act of Congress at the suggestion of Abraham Lincoln. Notable extensions have taken place in the meantime. The body which President Lincoln's administration created was called, and to-day is called, the National Academy of Sciences. I should like to read a portion of Section 3 of the Act of Incorporation:

"... the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States."

Mr. Davis: And subsequently, Dr. Jewett, this National Academy of Sciences has been augmented by other organizations?

Dr. Jewett: Yes, and by one in particular. In 1916 President Wilson asked the academy to organize a subsidiary body of broader membership as a measure of national preparedness. This body, called the National Research Council, accomplished such important results in organizing research and in securing cooperation of military and civilian agencies before and during American participation in the last war, that on May 11, 1918, President Wilson issued an executive order establishing the National Research Council as a permanent body. Perhaps the best way to illustrate the functions of the council, and at the same time minimize words, is to list its divisions. They are nine in number, as follows: Foreign Relations, Educational Relations, Physical Sciences, Engineering and Industrial Research, Chemistry and Chemical Technology, Geology and Geography, Medical Sciences, Biology and Agriculture and, finally, a division for Anthropology and Psychology.

Mr. Davis: Won't you explain briefly, Dr. Jewett, how the proper personnel is selected from among the scientists of the country?

Dr. Jewett: In the first place, I ought to state that the 300 men and women who constitute the membership of the National Academy are elected on the basis of outstanding eminence in their field of science. The academy is divided into sections corresponding to the various sciences. Thus, there is a section for chemistry, another for mathematics, one for engineering, etc. Each section, of course, has a chairman who is, himself, preeminent in that field. Further, it is safe to say that the circle of acquaintanceship of the members of any section extends outward to include practically every person in the country who can qualify as well informed in the subject-matter of the section.

The National Research Council is likewise divided along lines of the various sciences. It has its permanent committees or divisions with chairmen who are selected for knowledge, experience and business ability. These chairmen, on the one hand, are naturally well acquainted with the officers of the government departments whence the problems and questions arise—and, on the other, are well acquainted with the nation's outstanding experts, whether connected with universities or with private industry. Thus, it will be seen that the National Research Council is a sort of business organization which derives its guidance from the academy and has behind it the prestige of the nation's leading scientists. Through its numerous working committees, the National Research Council is made up of many hundred scientists and engineers.

Mr. Davis: I think it might help us, Dr. Jewett, if you could say a few words about some of the problems which the academy and its council have studied or are studying for the government. Of course, I realize that many of these problems may be confidential, but doubtless there are others which are not secret.

Dr. Jewett: Well, one problem which comes to my mind is that of highway research. The council has cooperated over a period of years with the United States Bureau of Public Roads and has done effective work in coordinating information and in encouraging investigations upon the planning, building and operation of highways. During the past year, at the special request of the Bureau of Public Roads, the council has devoted particular attention to the problem of highway safety. These studies have been carried on in cooperation with the highway organizations in a number of states and comprise such topics as: Non-uniformity of state motor-vehicle traffic laws; skilled investigation at the scene of the accident needed to develop causes; inadequacy of state motor-vehicle accident reporting; official inspection of vehicles; case histories of fatal highway accidents; the accident-prone driver.

Another program of a long-time nature, and one which very definitely relates to public welfare, although not particularly to military activity, is research upon narcotics. In the first place, much has been added through this work to our knowledge of the chemistry and pharmacology of narcotic substances. From over three hundred new alkaloid substances produced experimentally, several have been found which promise medical uses. Much of the clinical work has been done at the United States Public Health Service Hospital in Lexington, Kentucky. Another important phase of narcotics research has been the development of means for the control of these new drugs.

These are but single instances. Since the academy's organization over one hundred major problems, covering practically all fields of science, in addition to a host of lesser ones, have been submitted to the academy by the Federal Government. One of the earliest, and presumably it arose as a result of the building of the iron gunboat *Monitor* during the Civil War, was to study the magnetic

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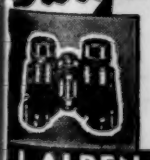

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compass with a view to compensating for the magnetic effect of ships built wholly or partly of iron. The findings arrived at by the academy are, I believe, standard even to this day.

Mr. Davis: Such problems are certainly of fundamental importance to the nation, Dr. Jewett. What are some of the current problems before the Academy and the Research Council?

Dr. Jewett: The most recent government request has to do with what kind of blind landing system should be adopted for American airplanes. Numerous systems have been demonstrated and the government has asked the academy to examine the evidence and advise as to a system which can be installed at all airports and on all airplanes.

Two other projects involve aviation. We are cooperating in aircraft production planes, both current and with a view to future developments. Also our psychologists are advising the Civil Aeronautics Authority on tests that can be used in connection with the training of thousands of college boys and girls to be airplane pilots. Not long ago the academy conducted for the government an extensive inquiry into lighter-than-air aircraft.

Mr. Davis: Many of the projects do not have a direct military bearing.

Dr. Jewett: That is true. For instance, the National Research Council is sponsoring research in aerobiology and scientists are flying aloft sampling the spores, bacteria, insects and other living things that the winds carry from place to place. Our program in endocrinology has achieved significant results that will not only add to knowledge but eventually save human lives. A conference called by the council this summer at the request of the government lent scientific aid to the United States Antarctic Expedition about to set forth. The Chemistry Division is just now surveying chemical research facilities in leading universities, and the council as a whole has undertaken to make a complete survey of the nation's industrial research facilities—both human and material.

Mr. Davis: How are these investigations paid for, Dr. Jewett?

Dr. Jewett: In part, expenses of investigations are paid by the department of the government posing the problem, but in part there are large expenses which we may call "going" expenses connected with organizations like the academy and the council—expenses which in private business would be analogous to "loading"—and these can not be billed to the government. To defray these and also to make possible many subsidiary lines of research, the academy has been very fortunate in attracting donations and gifts, the income from which amounts to about $200,000 per year. Private sources supply in large part, therefore, the funds which the academy and the council require, just as private sources form the chief support of the fundamental research programs of our universities.

Mr. Davis: It seems to me one of the most important contributions that has been made to American science is the training of leaders in research that has resulted from the National Research Council fellowships administered over a period of years.

Dr. Jewett: Yes, twelve hundred young scientists have been able to continue research training beyond the usual Ph.D. degree, and these splendidly equipped scientists are in many cases forging to the forefront of American science. I think, Mr. Davis, that the question of scientific mobilization for problems of national importance, whether of peace or war, can be summed up by saying that in the National Academy of Sciences and National Research Council the United States has an active operating agency which covers every field of fundamental and applied science. Further, that it is an agency which can bring to bear on any problem the best talent which the nation possesses.

Mr. Davis: Thank you, Dr. Jewett, for this insight into how science can be mobilized to aid our government and nation in times of peace and war.

ITEMS

SULFAPYRIDINE, the chemical remedy that has been saving lives threatened by pneumonia, has been given to seven patients with tuberculosis in the hope that it would be equally useful as a remedy for this ailment. This hope was aroused by reports of previous use of the chemical for treating guinea pigs with tuberculosis. Unfortunately, the remedy failed to help any of the human patients, Drs. Stanton T. Allison and Robert Myers, of New York, report to the *Journal* of the American Medical Association. Both sulfapyridine and its chemical relative, sulfanilamide, are proving useful in treating another condition, the usually fatal blood poisoning due to staphylococcus infection. Cases in which these drugs are believed to have helped patients recover are reported in the same issue of the *Journal* by Drs. William A. Thornhill, Jr., Howard A. Swart and Clifton Reel, of Charleston, W. Va., and Samuel L. Goldberg and Allan Sachs, of Chicago.

A NEW rival for the carbon-arc searchlights has appeared in a 25,000,000 candlepower searchlight, using three tiny water-cooled mercury arcs, which has been developed by the General Electric Company. While present-day searchlights need an attendant to adjust the carbons for best illumination, the new searchlight does not wear out, needs no adjustment and is designed for lights in inaccessible places. Ninety gallons of water an hour are pumped through the cooling containers of the mercury arcs and then passed to an automobile-type radiator where the fluid is cooled for recirculation. Though more convenient, the new searchlight is still below the present high-intensity searchlights in beam candlepower and effectiveness.

DELIBERATELY knocking out front teeth was a youthful fashion in Indian days, it appears from an investigation of Dr. Aleš Hrdlička, of the Smithsonian Institution. He recently returned from anthropological study in the Soviet Union, where he found for the first time evidence indicating that America's Indians and Siberia's New Stone Age natives both widely practised the ceremony of knocking out front teeth of young boys and maidens. The custom provides a new bond showing origin of the American Indian in Asia. In adult skulls from both countries, Dr. Hrdlička explained, there may be back teeth missing from abscesses or other conditions, but in many skulls there are front teeth which show signs of having been extracted long ago, with indications that it was done in youth. The condition is prevalent even now among Australian and African natives and with them it is done generally as a sacrifice or a test of endurance.

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SCIENCE NEWS

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PAPERS READ AT THE SYMPOSIUM ON TEMPERATURE OF THE INSTITUTE OF PHYSICS

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A SYMPOSIUM on "Temperature, Its Measurement and Control in Science and Industry," was held on November 2, 3 and 4 at the Hotel Pennsylvania, New York City, under the auspices of the American Institute of Physics, with the cooperation of the National Bureau of Standards, the National Research Council and officers and committees of scientific and technical societies. The symposium, the largest in its field to be held during the past twenty years, has gathered engineers, physicists, chemists and medical men from all over the country. Representing all fields of investigations, 127 scientific reports were presented, showing how temperature affects man directly or can be used to do new things and disclose new knowledge.

That athletes in severe muscular exercise can show body temperatures that normally would mean high fevers, was stated by Dr. Eugene F. DuBois, of the Russell Sage Institute of Pathology, Cornell University Medical School. He showed that the familiar 98.6 degrees Fahrenheit the clinical thermometer registers normally, is only one single spot between internal temperature and skin temperatures of 93.2 and lower. In severe exercise the temperature may run up to 104 degrees Fahrenheit. Just as the earth has broad zones of temperature, so, too, does the body have its temperature levels or zones. The torrid zone in man might be classed as that with temperatures of more than 105.2 degrees F., which can only be obtained by artificial fevers or when the body's temperature-regulating mechanism fails. Just below this, in what might be called the semi-tropics, is the familiar "fever" zone that is higher in temperature than normal and which comes from illness. With fever the skin temperature is warm. Here, too, come the higher temperatures of severe exercise which are accompanied, however, by cool skin. The body's normal temperature zone, corresponding to the temperate zone on the earth, is fairly wide. Below it come those body temperatures which are restored to normal values by shivering. And finally, analogous to the polar region on earth, is the body's zone of semi-hibernation where temperature regulation fails.

By turning their cells into a kind of living "glass" some microorganisms are able to withstand immersion into liquid air at temperatures of 190 degrees below zero Centigrade, was reported by Professor Basil J. Luyet, professor of biochemistry at St. Louis University. He stated that matter can exist in four physical states: as a gas, as a liquid, as a crystal and as a glass. Death by freezing comes because the temperature is lowered slowly. If an organism can be dipped into liquid air and pass on to the so-called vitreous state, some living tissues can be returned to a degree of vitality by quick warming to make them pass again through the danger stage of crystallization. Professor Luyet reported that he and his colaborators had used this rapid cooling to chill tissues from the epidermal cells of plants, moss leaves, frog's spermatozoa, isolated muscle fibers and myxamoebae. All these regained vitality on rewarming. He said: "Other protozoa or tissues experimented upon did not survive. One of the reasons for the lower resistance of the latter seems to be their too-high water content and the impossibility of sufficiently dehydrating them. These observations and those of other investigators . . . favor the theory that the structure required for vital activities is such that it is not destroyed by a lowering of molecular motion while it is destroyed by the withdrawal of some water molecules as when crystallization takes place."

Professor Otto Rahn, of Cornell University, pointed out that temperature is one of the three greatest physical factors controlling all life on earth. Not only are growth and synthesis speeded up by high temperature but also the processes of old age and decay. In all climates there is a balance between life and death and between development and deterioration. He said: "While the laws of temperature are inexorable, the ever-active powers of evolution have found a way around these laws by the creation of one of the great marvels of nature, the warm-blooded mammals and birds. All plants and all animals which can not control their body temperature display three cardinal points in regard to temperature: the optimum at which they thrive best, the maximum, which is the highest temperature at which they can still live, and the minimum or the lowest temperature at which existence is possible. Besides these three cardinal points . . . other temperatures are frequently mentioned, namely the temperature at which an organism is killed either by excessive heat or by excessive cold. Neither of these points is very definite. At maximal temperature, the organism ceases to grow but absence of this function does not mean death. If the temperature is raised slightly above the maximum, injury will set in very slowly, but the organism is capable of recovery for a long while. The higher the temperature the sooner is the repairable stage passed, but the length of exposure will always remain a factor. With death by freezing, so many possibilities are open that general statements are entirely impossible. Death may be due to chemical causes, to solidification of lipids in the plasma membrane preventing diffusion, to a mechanical tearing of cells or tissues through ice formation, to a change of the colloid state of the protoplasm or to still other causes. Very rapid freezing causes 'vitrification' of the cell moisture with serious injury. Microorganisms can be cooled in liquid air to −190 degrees Centigrade without being killed, while they may die during slow freezing at −2 degrees C. Thus, life as well as death is intimately dependent upon temperature because the rate of most chemical and physical reactions is controlled by temperature. Though we can not explain all the observed facts and though especially the causes of inhibition by low temperature are still obscure, we have no reason to assume that they will always remain unexplained."

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Drs. M. Nielsen, W. H. Forbes, J. W. Wilson and D. B. Dill, of Harvard University, described Harvard's four trained dogs, which will lie quietly on a net in a cold room at temperatures of from 32 to 53 degrees Fahrenheit and wear oxygen masks. Exact physiological studies were made of their body activity. Skin temperatures, respiratory rate, pulse rate were tested and blood tests were made. Three of the four dogs withstood the chilling tests well. They lay quietly, though not narcotized, in a semi-conscious condition most of the time. At these low temperatures the dogs shivered moderately while breathing room air and thus increased their heat production and maintained their body temperature. When they breathed gas mixtures with lowered oxygen content through their masks the shivering soon stopped and their metabolism returned to the basal level and the body temperature fell about two degrees Centigrade per hour. The greatest total drop in temperature was six degrees Centigrade. The temperature fell gradually until the dogs were switched over to breathing the air in the cold room. Then the body's metabolism suddenly increased four times and within a half hour the body temperature was back to normal. It is concluded that "The ability of the dog to withstand low oxygen depends more on the toughness of his central nervous system than on an unusual ability to take oxygen in the lungs."

Homeothermy, the ability to maintain an even temperature in the body within the range of optimum biological activity, is the major mark of superiority of the higher animals, according to Dr. H. G. Barbour, of the Yale School of Medicine. The hypothalamus and endocrine glands are actively concerned with heat production and control in the body, he said. The mechanisms for enabling the body to lose heat become effective later than those of heat production, he added. At birth or hatching neither heat production nor heat-losing mechanisms appear to be present in the mouse or pigeon. In rabbits, man and cats heat production means is present but no means of losing heat. In guinea pigs and in chickens both mechanisms are present at the start. The body uses water to store and transport heat because of its high heat capacity. Water too appears to have insulation value against cold when blood is withdrawn from the surface of the body down into the deeper regions as in digestion of food in the stomach.

The difficulties of measuring the temperatures of stars was described by Dr. G. P. Kuiper, of the University of Chicago. By knowledge of the laws of radiation the relation between the color of a star and its effective temperature can be obtained. This is the amount of radiation leaving the star per unit area of surface. "For less than a dozen stars" are the basic assumptions of this way of getting stellar temperatures fulfilled. For the very hot stars with temperatures of over 10,000 degrees absolute the ionization of stellar gases and the resulting spectra enable ideas of star temperatures to be obtained. The complications of this method are so great that only when the temperatures are over 10,000 degrees K. can the necessary simplifying conditions be introduced into the calculations.

THE traditional explanation of the skin's sensitivity to heat and cold was discounted by new findings reported by Dr. William Leroy Jenkins, instructor in psychology at Lehigh University. The thought that temperature sensitivity of the skin was concentrated in small warm and cold spot receptors arose from the discovery that the locations of these spots could be mapped with a small stimulator. Dr. Jenkins has carried forward the mapping technique and by the process of seriatim, or repeated mapping, has found that the single warm and cold spots do not exist. "Seriatim mapping," Dr. Jenkins stated, "reveals hills and valleys of sensitivity. Warm and cold spots are found only in clusters, and mapping with smaller and smaller sizes does not resolve these clusters into discrete units; they simply disintegrate without being resolved." As a new and better way to explain the temperature sensitivity of the skin, Dr. Jenkins proposes a "concentration hypothesis," which suggests that the sensitivity depends primarily upon the concentration of the receptors. Where the receptors are highly concentrated, the skin's sensitivity is high. Where they are sparse, the sensitivity is low. According to this view, the traditional warm and cold spots are merely peaks of sensitivity and do not mark the locus of individual receptors.

Strong emotions like anger are found to make the fingers cold, according to Drs. Bela Mittlemann and H. G. Wolff, of the New York Hospital and the Cornell University Medical School. Temperature differences of more than 12 degrees Centigrade were noted in some cases.

That the fingers and arms are one of the body's first means of maintaining comfort was reported by Drs. Charles Sheard, Marvin M. D. Williams and Bayard T. Horton, of the Mayo Clinic and the Mayo Foundation. Studies of skin temperature under various environmental conditions show that the enlargement of the blood vessels, known as vasodilatation, helps to bring more blood to the surface of the body and aids in its cooling if the temperature becomes too warm. As the temperature on the test subjects was increased step by step it was found that vasodilatation occurred first in the fingers and upper extremities and then later a similar action began in the feet, toes and lower extremities.

A method of oil prospecting by measuring temperatures in the earth at depths of 100 to 200 feet was described by Melvin C. Terry. It is not necessary to take the temperature measurements at extreme depths because the intrusion of high conductivity materials will disturb the pattern of normal temperature gradients. Working over the ground of producing Texas oil fields at Hastings and Friendswood, it was found that the line of constant temperature at 23 degrees Centigrade ran about 100 feet higher over the oil salt domes than it did in the region between them.

The world is getting warmer. There appears to be a trend to higher temperature, according to J. B. Kincer, of the U. S. Weather Bureau, Washington, D. C. He stated "That there have been major changes in geologic climate has long been known, but that climatologists have con-

sidered historic climate as a rather stable thing, with short period variations of considerable magnitude, but without especially significant secular trends covering long periods of time. However, since the turn of the century there has been such a persistent trend to higher temperatures, world-wide in scope, as to suggest that the orthodox conception of the stability of climate needs some revision at least.'' Mr. Kincer cited as examples the records at Portland, Ore., where 17 of the past 20 years have been warmer than normal. And at Washington, D. C., 17 years in the last 20 have been warmer than normal and every year since 1926 above normal. Capetown, South Africa, has had 19 of its last 20 years warmer than normal. The world's lowest naturally occurring temperature yet observed is minus 90.4 degrees Fahrenheit measured in Siberia in the month of February, 1892. The highest temperature ever recorded on the earth's surface was observed in Tripolitania in September, 1922, when the thermometer reached 136.4 degrees Fahrenheit.

Skin temperatures of women are higher in warm atmosphere and lower in the cold than are those of men, according to a report made by Drs. James D. Hardy, A. T. Milhorat and E. F. DuBois, of the Russell Sage Institute of Pathology, New York Hospital and Cornell University Medical College. This is one of the first investigations to be made on heat production in women. Most prior work on this question has been done on men. The temperature difference at the higher temperature is accounted for both by the level of skin temperature required to induce sweating and by the amount of sweat. ''The women did not begin to sweat until the calorimetric temperature was two degrees above the threshold for sweating in the men, and the amount of sweating was less. The lower skin temperature of the women in the cold is apparently due to a thicker insulating layer of superficial tissue.'' Up to temperatures of about 81 degrees Fahrenheit, the heat production of the body for both men and women was essentially the same. Above that temperature the women showed a significant decrease in heat produced by their bodies.

How blocks of different metals are being used to help to control high temperatures with thermostats was described by Drs. C. L. Thomas and Gustav Egloff, of the Universal Oil Products Company. These blocks are used for temperatures above 200 degrees Centigrade. A hole is drilled in the block and a porcelain rod is inserted. The differential contraction and expansion between the rod and the metal block creates a tiny motion which, by levers, throws on and off switches that control temperature. Aluminum blocks are used for temperatures up to 500 degrees Centigrade, while aluminum bronze works up to 800 degrees. Stainless steel (18 per cent. chromium and 8 per cent. nickel) is used for temperatures up to 1,000 degrees Centigrade.

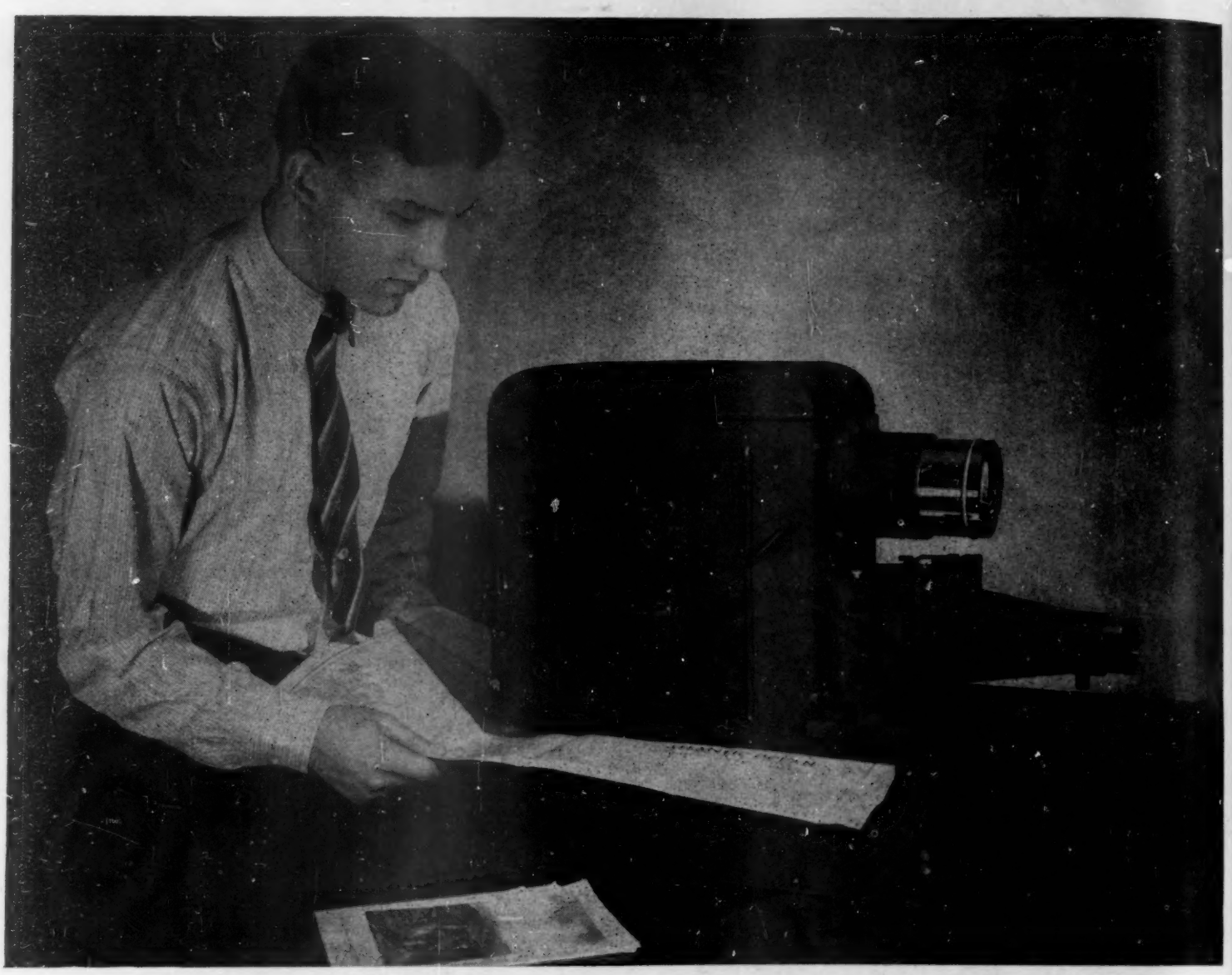
ITEMS

SCIENTIFIC research has become so important to American industry that it is something to advertise instead of an activity that is kept hidden, Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*, the journal of the American Chemical Society, told the Ohio State University Research Foundation's Fourth Industrial Research Conference on November 4. In the past twenty-five years research has produced so many new products and earned so much money for important industries that now some chemical concerns invest 7 per cent. of their gross sales in hiring brains and equipment to renew continuously their business. About $100,000,000 is spent annually in America for industrial research, Dr. Howe estimated. If the cost of development of research findings into commercial processes and products were included, this figure would probably be doubled. Now there are over 2,000 laboratories doing industrial research, compared with a hundred or so a couple of decades ago.

THE San Francisco and the New York World's Fairs have enabled science to make its greatest analysis of deafness among the population ever undertaken, H. C. Montgomery, of the Bell Telephone Laboratories, reported to the meeting of the Acoustical Society of America at Iowa City on November 4. Over half a million people took the hearing tests at the telephone exhibits of the fairs. The largest previous survey on deafness was that of the U. S. Public Health Service in 1936, which studied the results on 9,000 persons. If the World-Fair visitors are a fair sample of the population, then eight people out of every thousand you meet have difficulty in hearing direct conversation. Forty people out of a thousand have trouble hearing in auditoriums. Only one in 400 will have difficulty in hearing over a telephone.

MORE food value per potato, per egg, per any-food-unit will be the objective of a new program of basic research initiated by the U. S. Department of Agriculture, to be centered on land adjacent to Cornell University, and to be conducted under the supervision of Dr. L. A. Maynard, professor and head of the laboratory of animal nutrition at Cornell. Hitherto, researches aimed at increasing agricultural production have striven primarily to boost the quantity of plant or animal material to be obtained from a given acreage. The new program will have as its first objective the improvement in quality, in terms of availability in human digestion and nutrition. First thing to be undertaken, according to the new plan, will be an investigation of soil minerals as they affect the yield and quality of crops. Scheduled for examination are not only the major mineral nutrients, like phosphorus, but also the so-called trace elements like cobalt, manganese and boron, which are necessary for good plant and animal health, but which need be present in only a few parts per million of the soil water.

''CRAZY TOP,'' a recently discovered disease of corn, has been found afflicting stalks in the wetter parts of fields in Iowa, Illinois and Indiana, Dr. Benjamin Koehler, of the Illinois Agricultural Experiment Station, reports in *Phytopathology*. The disease, cause of which is still unknown, changes the normal tassel at the top of the stalk into a mass of small, branching stems and leaves. Sometimes the ear is affected as well. Search for a possible causal organism has been hampered by the fact that the abnormal stalks were not noticed until late in the season.



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SCIENCE NEWS

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CENTRIFUGE FOR TESTING MINES AND BRIDGES IN NEW COLUMBIA SCHOOL OF ENGINEERING RESEARCH

AT Columbia University's School of Engineering, celebrating its seventy-fifth anniversary, a centrifuge method of engineering testing will be demonstrated publicly for the first time on November 10.

Professor Philip B. Bucky, of the Columbia School of Mines, and his students have built an enormous centrifuge in which can be placed models of the underground workings of a mine or models of bridges built to scale using transparent bakelite plastic. These structures are whirled faster and faster in the centrifuge merry-go-round, and as they whirl the centrifugal force stresses them and thus tests them. A force of 2,000 times gravity is created.

In the case of the mine structure, the problem is to find just how far miners can go in cutting holes in the rock they are mining. Holes might cause the rock to smash to bits under the thousands of tons of other rock pushing down from above. The stress built up in the centrifuge substitutes for the real stress that might be encountered under actual working conditions. The miniature block of rock collapses when the speed is high enough, just as the real mine would under the force of gravity. Professor Bucky can thus tell the mining engineers in a real mine how far they dare have the miners go with safety.

Light is used to measure the stress in the whirling bridge models. Polarized light, light that vibrates in one direction only, from a powerful mercury arc lamp, is flashed on and off so rapidly in exact synchronism with the centrifuge that the transparent model bridge is seen as though it were standing still. Bands of light and dark move through the model and these photo-elastic fringes enable the Columbia engineers to calculate just how and where a real bridge of that same design will be stressed in actual service.—WATSON DAVIS.

FLICKERING SEARCHLIGHT BEAM FOR THE STUDY OF THE ATMOSPHERE

THE piercing, puzzling searchlight beam which mystified residents of northwest Washington last summer on moonless, dark and clear nights was explained on November 12 at the meeting of the Philosophical Society of Washington by Ellis A. Johnson, of the Carnegie Institution of Washington.

No ordinary searchlight beam was that seen by Washingtonians. Its brilliant beam flickered ten times a second and identified it, for scientific research, so that its scattering at heights of as much as 24.8 miles could be detected.

The experiments, Mr. Johnson reported, seek to probe the upper atmosphere for its secrets of temperature, density, presence of clouds and other important information at heights which are beyond the reach of stratosphere flights with balloons. Moreover, the new searchlight experiments tap that region of space lower than the radio reflecting layers in the ionosphere. The new technique thus investigates the "no man's land" of the atmosphere.

While the current experiments have been preliminary, seeking mostly to show the feasibility of the method, they indicate that studies can be carried out on the height of water vapor in the atmosphere, the amount of turbulence, the winds, dust, fluorescence and absorption of these upper altitudes up to nearly 20 miles. Actual measurements have been carried out at this height and it was found that the beam itself could be detected up to 40 kilometers, or about 24.8 miles.

In outline the searchlight experiment is simple. The beam of a great searchlight was directly upward and made to flicker (modulate) about ten times a second by an automatic Venetian blind type of shutter. Some three and a half miles away was placed a large mirror, containing at its focus a photoelectric cell. This mirror pivoted upward and caught light scattered from the beam in the sky. The photoelectric current generated by this scattered light was amplified in a special radio amplifier developed by Mr. Johnson, which is so sensitive that it can detect currents of only .000,000,000,000,000,032 amperes. From the geometry of the searchlight and the receiving mirror the altitudes at which the beam is studied can be calculated. The modulated, flickering nature of the light makes it possible to differentiate it from the general background light of the night sky. Even so, it was necessary to work only on clear nights without moonlight and at times when there was little haze at low altitudes. The experiments indicate that with a 60-inch searchlight and a 60-inch mirror as a receiver, the study of the upper atmosphere could be pushed to 90 kilometers, or nearly 56 miles.

THE TRANSMUTATION OF PLATINUM INTO GOLD

THE ancient alchemists used to talk of transmuting base metals into gold, but in results accomplished little. Investigators at Columbia University, as a demonstration stunt, achieved a transmutation of the elements which results in gold. The starting point was not base metals but precious platinum.

The occasion was the seventy-fifth anniversary of Columbia University School of Engineering, which was founded as the first School of Mines in the United States. The modern alchemists were Dean George B. Pegram, of the Columbia Graduate Faculties, and Professor John R. Dunning, of the department of physics.

The method was to place platinum for some hours near a long glass tube containing a small amount of radium which emitted atomic particles that, by bombardment, turned platinum of atomic weight 195.25 into gold of atomic weight 197.2. The radioactive gold in turn emitted particles which alone made possible the detection of the transmutation.

Other demonstrations included: The detection of radioactive sodium in the human body and its circulation by

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the blood; the collapse of a model subterranean mine roof structure by whirling it in a centrifuge to simulate the force of gravity in a real mine; the crushing of an eight-foot brick masonry pier in the compression testing machine of the school of engineering; the demonstration of water seepage under power dams and through various types of soil structures; a demonstration of the manufacture of isotopes by Professor Harold C. Urey.

SOLAR RADIATION

TRAPPING the heat of the sun as it falls on the roof of a house and storing it in the basement for future use is to be attempted at the Massachusetts Institute of Technology soon, as part of a long-range program on the possibilities of using solar radiation as a direct source of energy.

An experimental house, which it is planned to heat during the winter, air condition during the summer and possibly even supply with power, all with the energy of sunlight, has already been constructed and the research is expected to begin at once.

One of the major features of the house is a large, well-insulated water storage tank which is to be used in ironing out the fluctuations in heat which are inevitable with a source as variable as the sun. The heating system is based on a method of forcing air either over the hot surface of the tank or through the coils of a refrigeration system which is also to be run on energy stolen from the sun.

Professor Hoyt C. Hottel, who is in charge of the program, plans to try several types of "heat traps," or energy collectors, during the research. First attention will be devoted to a shallow, box-like device which will be placed in a recess in the building's roof. For a bottom this box has a thin sheet of metal, painted black to absorb as much of the sun's heat as possible. Firmly fixed to this bottom is a series of small, thin-walled metal tubes which are to be heated by contact with the sheet and which will then pass this heat on to water circulating through them. This box has a series of glass covers, separated by dead air, through which nearly all the sunlight can pass but through which little heat can escape back to the outside. The sunlight, as it strikes the metal sheet, is converted into heat and the whole arrangement has a layer of mineral wool beneath it to prevent heat escape in that direction. The warm water in the coils is then piped, through carefully insulated tubes, to the well-insulated storage tank where the engineers expect to keep it hot anywhere from a few weeks to six months, depending on the size of the tank.

The best size for these units, the most heat-absorbent paint, the most effective number of glass plates and the best angle at which to slope the roof are among the problems to be investigated. Professor Hottel emphasized that he and his colleagues are well aware that the amount of solar heat in New England would make domestic heating by solar radiation uneconomical in comparison with other heat sources, but there is sufficient sunshine in this region to test the efficiency of heating systems for those localities where the climate is less rigorous.

The research is one of several projects planned at the Massachusetts Institute under the terms of a gift of nearly $650,000 from Dr. Godfrey L. Cabot, of Boston, "for research on the utilization of solar radiation for the tasks of man."

INSULATION AND HEAT LOSS

ADEQUATE insulation of a house against heat loss can cut the fuel bill nearly in half, E. S. Draper, director of the department of regional planning studies of the Tennessee Valley Authority, reported at the meeting in New York on November 6 of the Committee on Hygiene of Housing of the American Public Health Association.

Mr. Draper announced at the same time that a simple heater practical for central heating of small houses, improved after tests in a TVA house at the Gilbertsville Dam construction community, is now in production for the open market.

The insulation studies were carried out in two identical four-room houses in the Hiwassee Dam construction community. Installation of electrical heaters made it possible to record with great accuracy the heat loss in the two houses. One of them was insulated throughout by wool bats in the walls and over the ceiling and an insulation board under the floor joists. Both houses had both doors weatherstripped. Both families were held to the same schedule of window-opening in bedrooms at night, windows closed by day, and the heaters were turned on and off at the same time. The reduction in total heat loss in the insulated house was 44.75 per cent. Cost of insulation, including labor and materials, was about $200.

The simple heater described by Mr. Draper was designed to effect a reduction in the capital cost of central warm air heating over that of installing the warm air furnaces then available on the market. The object was to have a primary heat source (without provision for air filtering or humidification) placed in an exceptionally small first floor heating chamber centrally located so that it might service all rooms of a small house without the usual extensive system and basement.

COMETS

THE discovery of a new and unexpected twelfth magnitude comet on November 1 by Clarence L. Friend, of Escondido, Calif., brings to twelve the number of comets which so far have been sighted by astronomers during 1939. Seven of these comets have been of the periodic type which return to the region of the sun and earth at regular intervals which astronomers can calculate accurately. As might be expected, professional astronomers working in large observatories rediscovered all these returning comets.

Of the five new and unexpected comets found so far this year, two have been found by amateur astronomers, two jointly by an amateur and a professional and one by a professional astronomer alone.

The significant mark of the new Friend comet is its rapid motion. From its originally discovered position in the "keystone" of Hercules near right ascension 16 hours 52.9 minutes and declination plus 34 degrees, three minutes, it is moving rapidly east and south.

The first comet of 1939 was the unexpected one found

independently on January 19 by Kosik, professional observer at Tashkent Observatory, U.S.S.R., and Leslie C. Peltier, Delphos, Ohio, an amateur who has discovered seven comets.

The second comet of the year was the return of the Brooks-Winnecke comet found on March 17 by Dr. H. M. Jeffers, of Lick Observatory. This is comet 1939 c.

On March 17, too, Dr. Y. Vaisala, director of the observatory at the University of Turku, Finland, reported the discovery on asteroid photographic plates of a new comet. The Vaisala comet was granted designation 1939 b.

On April 18 was found comet 1939 d, a new comet and one of the "most discovered" of all the year. First reported by a professional observer, Hassel, at Oslo, Norway, it was later found that two Russian amateurs, Jurlof and Achmarof, had discovered it just ahead of him. A triple name, the Jurlof-Achmarof-Hassel comet, was thus assigned. Many observers all over the world reported independent discoveries of this comet for some days following.

The reappearance of the Kopff periodic comet (1939 e) was announced by Professor G. Van Biesbroeck, of Yerkes Observatory of the University of Chicago, on April 22.

The periodic Schwassmann-Wachmann comet (1939 f) was found anew by the professional observer Jackson, at Johannesburg, S. A., on June 12.

Periodic comet Brooks II (1939 g) was found by Dr. H. M. Jeffers, at Lick, shortly afterward.

On July 28 the new comet 1939 h was discovered by the French amateur astronomer Roger Rigollet, a variable star observer.

On July 31 came the one comet discovery of the year which has not yet been confirmed. This was the announcement of a seventh magnitude comet by the professional observer Kaminsky at Tashkent Observatory, U.S.S.R. While reported seen from Italy, also, the comet could not be located by astronomers elsewhere, and it has not yet been given a number designation.

Periodic comet Tuttle reappeared on August 14 when Dr. H. M. Jeffers, of Lick Observatory, found it on a photograph taken with the 36-inch Crossley reflector. It was received designation 1939 i.

September was without comet discoveries, but on October 14 Professor G. Van Biesbroeck, of Yerkes Observatory, announced the reappearance of the Giacobini-Zinner comet. This is comet 1939 j.

On the same astronomical announcement card listing the new Friend comet is the reported rediscovery of the Faye periodic comet by Dr. H. M. Jeffers, of Lick Observatory, on November 3.—ROBERT D. POTTER.

ITEMS

COMPLETELY successful operation of the experimental apparatus was obtained by the substratosphere expedition of the University of Chicago on October 23, according to Professor Arthur H. Compton, of the university. Rising to 29,000 feet, while scientists breathed oxygen, the airplane bore aloft a Wilson cloud chamber apparatus to make visible the tracks of the cosmic ray particles. Dr. Compton said that "Preliminary findings show the presence of cosmic ray tracks for every expansion of the cloud chamber at altitudes of over 20,000 feet as compared with the rate occurrence of the tracks at sea level." The major effort of the expedition was to find and study "slow" mesotron particles, the heavyweight charged particles, some 160 times as massive as ordinary electrons. The rate of mesotron production near 30,000 feet was very greatly increased. Professor Compton directed the flight by radio from the ground. In the plane, running the apparatus, were his assistants, Drs. Gerhardt Herzog and Winston Bostwick.

WARM-BLOODED animals can be sent into hibernation artificially by injecting insulin, or a combination of insulin and magnesium chloride, into their veins, according to Dr. Paavo Suomalainen, of the Helsinki Biochemical Institute. Working with European hedgehogs, Dr. Suomalainen found that the injections caused a drop in blood sugar content to less than half normal, and produced the cold-blooded state characteristic of warm-blooded animals in hibernation. The animals remained asleep as long as he kept them in a refrigerator, at temperatures around freezing point. When he removed them to a warm room, at a temperature of from 70 to 75 degrees Fahrenheit, they awoke and returned to the normal warm-blooded state.

BACTERIA have been shown to be able to change the eye color in Drosophila, or fruit flies, in experiments reported by Dr. Edward L. Tatum, of Stanford University, who has been working on a project financed by the Rockefeller Foundation. Such changes have hitherto been considered to be a monopoly of genes, or hereditary units within the cells of the insects themselves. The change, from white to brown color in the eyes, is brought about by a hormone produced by the bacteria, working in conjunction with tryptophane, an amino acid which is part of the flies' diet. The bacteria-produced hormone seems to be identical with a hormone produced by the flies, under certain conditions. Dr. Tatum made his discovery when the tryptophane used in feeding his fruit flies became contaminated with a still unnamed species of bacterium.

PARA rubber trees are being tried out in three nurseries at different altitudes in the Ethiopian highlands, in the hope of eventually making Italy independent of foreign sources of rubber. The plantings at the lowest altitude, at Gambela (2,000 feet above sea-level), have been most successful; the seedlings have reached a height of about two feet in the first year after sowing.

DINOSAURS may have died out because the world got too hot for them, not because it became too cold as commonly conjectured. This reversal of the usually accepted theory of dinosaurian extinction is suggested by Dr. Raymond B. Cowles of the University of California at Los Angeles. Dr. Cowles bases his theory on the known facts about present-day reptiles, distant cousins of the dead giants of the Mesozoic. Reptiles become sluggish when chilled, but when over-heated they die outright, even the lizards that are supposed to be happiest on a hot rock, he says. Any temperature above 98.6 degrees Fahrenheit is bad for them.

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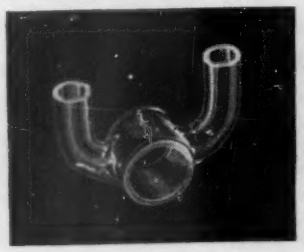

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SCIENCE NEWS

Science Service, Washington, D. C.

MESOTRONS

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MESOTRONS, the fiercely energetic particles generated by cosmic rays far up in the stratosphere, "commit suicide" on their way to earth.

They dash in uncountable hordes from their high birthplace toward sea-level, but on the way more than half of them disappear. That much was known. What was not known was whether they died from collisions with the atmosphere or from some other cause.

An elaborate series of experiments conducted all the way from Chicago to the top of 14,259-foot Mount Evans, where the world's highest laboratory is situated, has established that the mesotrons disintegrate according to a fixed schedule or life-span which seems largely independent of outside conditions.

Their suicidal impulse resembles that of the disintegration of radium, which is subject to no outside conditions possible for man to establish.

Dr. Bruno Rossi, the Italian physicist now a research fellow of the University of Chicago, and head of the party that made the experiments, computes the average life-span of a mesotron, dashing toward earth at a speed approaching that of light, as 27/10,000,000th of a second. He plans to return to the mountains with more equipment next summer, for further investigation into the nature of mesotrons and of cosmic rays. He and his party, which included Professors J. Barton Hoag, Winston Bostick and O. E. Polk, of the University of Chicago, and Professor Norman Hilberry, of New York University, brought an ordinary old school bus from Chicago to Mount Evans.

On its floor was installed a ton and a half of equipment. It included three cosmic-ray counters, with five inches of lead on top to insure that only the powerful mesotrons would get through. Boxes contained several hundred pounds of powdered graphite.

Observations were taken at Chicago, elevation 580 feet; Denver University campus, 5,200 feet; Echo Lake, west of Denver on the flanks of Mount Evans, 10,816 feet, and at the top of the mountain at the cosmic ray laboratory of Denver University, 14,259 feet. At Chicago, the counters clicked at the rate of 5 a minute; at Denver, 7; at Echo Lake between 9 and 10, and at the top of the mountain, 12. This only confirmed previous observations, which showed more mesotrons at high atmospheric levels.

When the last count had been checked and re-checked at the top of the mountains, the observers heaped graphite, in deep trays, on top of the counters until there was a layer 55 centimeters thick or about 20 inches. This thickness was calculated to represent the same amount of mass as that contained in the air blanket, 3,641 feet thick, between the top of the peak and the altitude of Echo Lake.

Now, to reach the counters, the mesotrons would have to pass through the same mass, but they could pass in much less time. If the number of mesotrons now registered remained more numerous, it would show that many mesotrons passed successfully through the mass. But it would also show that many of them disintegrated in the greater time—short as it seems by ordinary measurements—that it takes them to travel through 3,641 feet of air rather than 20 inches of graphite.

The clicks at the mountain-top decreased to about 11 a minute, but there were still more than the 10 a minute registered at Echo Lake. Some mesotrons, therefore, "commit suicide" without outside impulsion, on the way down to earth.

THE CAUSE OF SPRUE

(Copyright, 1939, by Science Service)

A NEW theory of the cause of sprue, serious disease of the tropics which also occurs in the United States and other temperate regions, was announced by Dr. Edward B. Vedder, of the George Washington Medical School, at the opening session on November 21 of the American Society of Tropical Medicine, meeting at Memphis.

Sprue, Dr. Vedder believes, is caused by a failure of the tiny but powerful pituitary gland at the base of the brain. This little gland produces a number of hormones, among them one called prolactin, which stimulates milk secretion, and which also has an effect on the digestive tract. It is lack of this hormone which Dr. Vedder believes causes sprue, and he would like physicians to try the hormone as a remedy for their sprue patients. Most effective remedies for sprue at present are liver extract or some other source of the vitamin B_2 complex, but Dr. Vedder believes the gland hormone would prove a better remedy.

Sore mouth, anemia and digestive disorder are characteristic symptoms of sprue. The digestive disorders set up a vicious cycle, because the sprue patient, already unable to absorb enough of the B vitamins, has more and more trouble getting enough of these vitamins which he needs to remedy his illness. In severe cases they must be given by hypodermic injections. A number of investigators have concluded that the digestive disorder and vitamin deficiency were important parts of the picture, but no satisfactory explanation for what starts the vicious cycle has hitherto been forthcoming.

The start of the digestive disorder, Dr. Vedder believes, is the failure of the anterior pituitary gland to produce enough prolactin to keep the digestive tract functioning smoothly. Tropical service, he suggests, precipitates the pituitary gland failure in some persons, but such gland failure may occur without the precipitating effect of long periods of tropical heat, which may explain the nearly two hundred cases of non-tropical sprue in medical records.

GERM-FREE SURROUNDINGS FOR INFANTS

(Copyright, 1939, by Science Service)

PROTECTION for babies in maternity hospitals and infants' homes, from the germs they unwittingly give each other, is a leading topic in the two-day colloquium on newest progress in bacteriology now in progress at the University of Notre Dame.

On the Press

The Gonococcus and Gonococcal Infection

Describing new methods of diagnosis and treatment and the effectiveness of each, this volume is of special interest to both the research worker and the practitioner. It contains 32 papers, by 35 authors, presented as a symposium at the Milwaukee meeting of the Association in June, 1939. The following principal subdivisions indicate the scope and thoroughness of the discussions.

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II. Chemistry of the Gonococcus
III. Experimental Gonococcal Infection
IV. Pathology of Gonococcal Infection
V. Immunity in Gonococcal Infection
VI. Gonococcus Carriers
VII. Extragenital Gonococcal Infection
VIII. Biologic Side Effects
IX. Epidemiology of Gonococcal Infection
X. Diagnosis of Gonococcal Infection
XI. Treatment of Gonococcal Infection—Biologic
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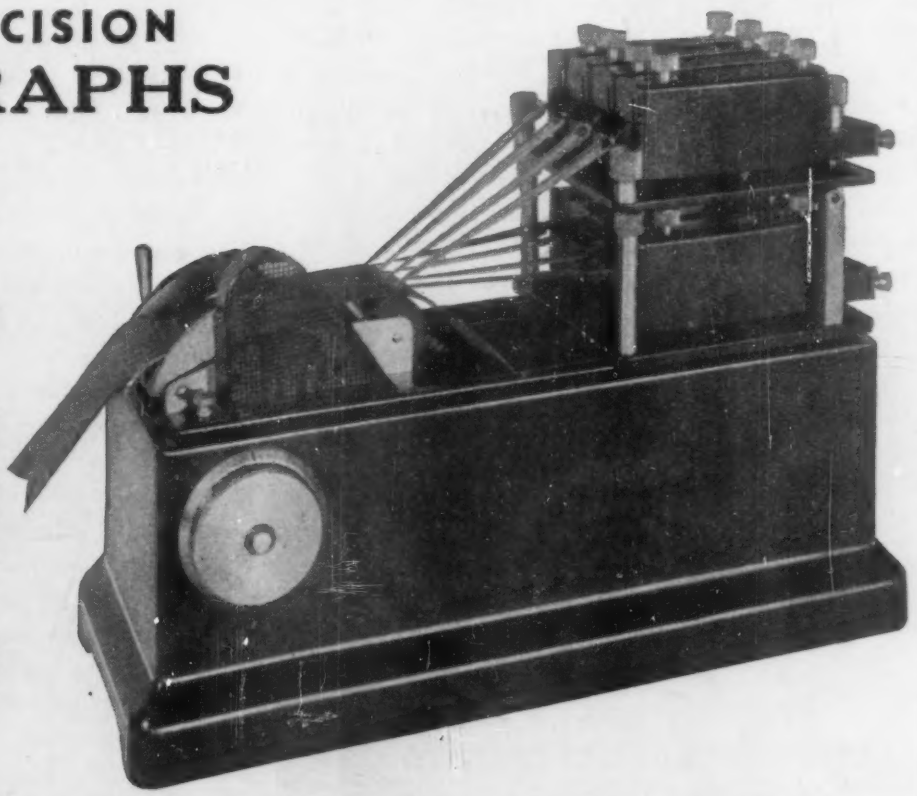

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Two principal systems to obtain this protection have been developed. In one, brought to its highest point by Professor James A. Reyniers, of Notre Dame, emphasis is placed on the complete isolation of all babies, brought about by keeping each one in a tiny room or cubicle, kept as germ-free as all imaginable precautions will insure.

The other system, developed by Professor William F. Wells, of the University of Pennsylvania, depends on floods of ultra-violet radiation across doorways and other critical areas in the hospital, which massacre the germs as they float through the air. Both systems are now under full-scale practical test at a well-known home for babies.

Animals and plants brought into the world without the contamination of germs, which is the fate of all ordinary living things, and kept germ-free throughout their lives, have been produced in Professor Reyniers' laboratory, and adaptations of his technique, as well as other methods, are now in use by a number of research workers. In his method, the young guinea pigs or other laboratory animals are born by Caesarian operation under completely aseptic conditions, within big tank-like cages where they are kept as long as necessary, receiving only sterile food, water and air. He has brought up guinea pigs, chickens and other animals from infancy to full growth, without their ever being invaded by a single discoverable germ.

Getting germ-free plants is usually a simpler job, according to Dr. Philip R. White, of the Rockefeller Institute laboratories at Princeton, N. J. The internal tissues of plants are usually naturally germ-free; it is a question simply of getting seeds out of a pod, or cutting tissues out of the inside of a stem or root, without their becoming contaminated. Many kinds of seeds have coats so resistant that they can be washed in effective antiseptic solutions without injuring the embryo plants which they contain. Dr. White described the method by which he obtains germ-free cuttings of roots, which he grows in flasks of nutrient fluid, maintaining them indefinitely without connection with any stems. In such cultures of non-green plant tissues he has proved that a little iron is as necessary to them as it is to the chlorophyll-containing leaves and green shoots. One part of iron in 10,000,000 of solution makes all the difference between life and death to simple tissues.

Other uses of germ-free techniques were set forth by Dr. R. W. Glaser, of the Rockefeller Institute, and by Dr. Oram Woolpert, of the Ohio State University. Also discussed at the colloquium were exceedingly delicate mechanical devices, which make it possible to insert a single germ, or a germ-size dose of a drug or virus, into a single living cell, to study results on this smallest of all experimental bases. Applications of these techniques have been made to many practical problems in diseased conditions of plant and animal cells, as well as to cells in normal states of life and growth.

RELATION OF QUARTZ DUST TO SILICOSIS

(*Copyright, 1939, by Science Service*)

MEDICAL men are now attacking the problem of silicosis by attaching a small transparent "window" to the ears of rabbits, it was reported to the meeting of the Air Hygiene Foundation by Dr. Eliot R. Clark, professor of anatomy of the University of Pennsylvania, and Darrow E. Haagensen.

A tiny sterile microscope viewing window, designed by Dr. R. G. Williams, associate professor of anatomy at the University of Pennsylvania, was attached last April to a rabbit's ear. Inside is a space only 1/333 of an inch thick in which the tissue of the ear could grow normally. Last June minute specks of silica ranging in size from one to seven microns (a micron is 1/25,000 of an inch) were placed on the tissue. A few particles up to 30 microns were also present. The cover was then placed over the microscope chamber, and the tissue cells as they sought to live in the same environment with the silica have been photographed daily.

While the important research must be continued much longer before final conclusions can be determined, it already appears that:

1. A relatively stationary grouping has developed among living cells called macrophages which have ingested, or taken in, the smaller particles of silica.

2. The silica laden cells tend to be very sluggish but seem to move slightly from day to day. They show grouping tendencies with occasional slow scattering and regrouping. Some of the larger particles from 15 microns and up in size appear to lie outside the cells and are not influenced by the tissue fluids.

3. Connective tissue has grown into the chamber and completely covered the observational area. As far as can be determined the lymphatic capillaries are normal as is the rich blood vessel plexus. Not even a mild inflammatory condition has appeared.

In a separate report Dr. Clark described the history of the use of observational "windows" placed over living tissues and showed that the tail of the tadpole, the bat's wing and the web of the frog's foot have all been used at one time or another for research.

Professor Philip Drinker, of Harvard University, chairman of the Foundation's Preventive Engineering Committee, describes studies seeking to learn what size of silica particles seem to have the most rapid effect in producing cell changes. Ground flint, consisting of 99.7 per cent. silica, was carefully separated into four sizes of 3.30, 1.65, 1.04 and 0.62 microns. Sterile suspensions of these fractions were injected into ear veins of rabbits twice at three-month intervals, and the animals were killed and autopsied periodically. Examination of the liver sections indicated that the fine particles were taken up more rapidly than the larger ones. There appears to be no striking effects for the larger size particles, while it seems in these preliminary studies, that the smaller sizes produce the greatest changes.

The knowledge obtained will be useful to engineers in designing ventilation and filtering systems for mines and other places where silica dust is prevalent, and will also be of greatest use in the design of dust respirators.

PNEUMONIA CONTROL

THE latest aid in the fight to save lives threatened by pneumonia, especially among children, is a new, speedy diagnostic technic which can shorten to six hours or less the time before starting effective treatment. Details

the new technic are reported by Dr. Franklin D. Poole and Miss Mildred D. Fousek, of the Orphan Asylum at New Haven and Yale University School of Medicine, in the *Journal* of the American Medical Association.

Rapid typing of pneumonia germs found in the patient's sputum, in order to determine which type of anti-pneumonia serum should be used in treatment, has already been accomplished, but often in children and sometimes in adults delay still occurs because of difficulty in obtaining sputum for the test. At Yale University the difficulty has been surmounted by applying the usual speedy typing technic to material obtained by swabbing the patient's nose. The method is valuable, it is pointed out, even though many pneumonia patients are now treated with the chemical, sulfapyridine, instead of with anti-pneumonia serum, because it is desirable for the doctor to know whether the pneumonia is caused by a pneumonia germ or by the streptococcus.

Small doses of sulfapyridine given for a short time in treatment of pneumonia in children are recommended by Drs. Charles Hendee Smith and Rosa Lee Nemir, of New York, in a report of their results with sulfapyridine treatment in 93 cases of pneumonia in children, which appears in the same issue of the *Journal*.

The value of sulfapyridine in saving lives, especially from Type III pneumonia for which serum treatment does not have as good a life-saving record as it does in other types, was stressed in another report to the *Journal* by Drs. Norman Plummer and Herbert K. Ensworth, of New York. Among 270 sulfapyridine-treated patients at New York and Bellevue Hospitals there were only 34 deaths. Of these, 11 died within 24 hours of the beginning of treatment, which reduces the death rate in this group to 8.5 per cent. Serum treatment was used in addition to sulfapyridine in 102 of the cases. In serum-treated pneumonia cases a death rate of about 18 per cent. to 20 per cent. has previously been reported from Bellevue Hospital. Besides reducing the death rate, sulfapyridine shortens the period of fever and sterilizes the blood stream.

ITEMS

THE earthquake that jarred several Eastern cities on November 14 had its epicenter in New Jersey, about 15 miles southeast of Wilmington, Del., according to a first approximation by the U. S. Coast and Geodetic Survey, based on data obtained telegraphically by Science Service. Time of origin was 9:53.9 P.M., EST. Geographic coordinates were latitude 39.7 degrees north, longitude 75.4 degrees west. This is the fifth earthquake felt in New Jersey within a decade. Most recent was one on August 23, 1938, near Mt. Holly, followed by a couple of light aftershocks. Other New Jersey earthquakes were recorded on May 31, 1937, on the sea coast; January 24, 1933, near Trenton, and January 26, 1931, in the Moorestown-Riverton neighborhood.

SEATTLE'S earthquake, that cracked windows and pavements on November 13, had its epicenter about 60 miles southwest of the city, according to a provisional determination by seismologists of the U. S. Coast and Geodetic Survey, based on data collected telegraphically by Science Service. The spot lies a little to the south of Mount Olympus National Monument, in a rugged, mountainous, almost uninhabited region. Geographical coordinates were given as 47.5 degrees north latitude, 123.5 degrees west longitude. Time of origin was a quarter of an hour before midnight, Pacific time, or 2:45.8 A.M., EST.

DUST storms may swirl again unless something happens to break the grip of the severe drought, which still continues unrelieved as autumn merges towards winter. The U. S. Weather Bureau states that "In the southwestern Plains, especially western Kansas, the soil is dry, loose, and subject to drifting by high winds." Light rains over parts of the northern central valley, particularly in the Great Lakes region, brought temporary relief, but the moisture is confined to the topsoil, for immediate benefit of fall-sown grains. Deep wells are being put down, seeking water for thirsty livestock. Over the greater part of the principal crop-producing regions, however, it is still too dry for fall seeding. Indeed, farmers in the Corn Belt are complaining that it is not only impossible to plow, but that they can't even mend their fences because the soil is so dry and hard that they can't dig post-holes.

BENJAMIN FRANKLIN wanted the turkey, not the eagle, to be the national bird of the United States. Yet not quite: for the turkey that graces our tables on Thanksgiving Day is not the native American bird that Franklin had in mind. The tame turkey of the barnyard is not the same species as the wild turkey that once roamed all the eastern woods. It is a tropical cousin, brought up by indirect route from below the Rio Grande.

WOUNDS incurred by persons working in the Russian Arctic are said to heal more rapidly than usual if they require stitching, but more slowly if they are left open. Paradoxically, both effects are credited to the relatively germ-free Arctic air. Germs in closed-up wounds cause inflammation and suppuration, but on minor, open wounds they stimulate the natural self-closing and healing processes.

THERE are lambs on the outskirts of Washington whose sires have never been east of Idaho; lambs in Idaho whose sires live in the pastures of the U. S. Department of Agriculture station at Beltsville, Md. Airplanes carried the prize rams' semen that made these long-distance breedings possible. This animal parentage at a range of a couple of thousand miles is only the most spectacular aspect of the rapid development of the technique of artificial breeding in this country. A little over a year ago, it was well established in only one state, New Jersey. Now there are artificial breeding associations in fifteen states, either actually operating or in process of formation. The territorial range covered is literally from Maine to California. Artificial breeding enables a farmer or rancher to have his new stock sired by the choicest animals available, regardless of distance, at fees so moderate that it becomes unnecessary for him to maintain sires on his own place or to patronize near-by owners of male animals of possibly less desirable qualities.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SEPARATION OF ISOTOPES

HYDROGEN cyanide, HCN to chemists, is perhaps the deadliest chemical known. Yet this poison is being used by Dr. Harold C. Urey, of Columbia University, in his latest separation of varieties of elements, called isotopes. By demonstrating that there actually existed a kind of hydrogen double in mass the ordinary sort, by producing heavy water whose hydrogen was of this deuterium of mass 2, Professor Urey won the Nobel prize. Then high concentrations of heavy oxygen were obtained. Later he separated heavy nitrogen of mass 15 from the ordinary nitrogen of mass 14.

Now he is accomplishing a separation of heavy carbon of mass 13 from the much more abundant and common carbon of mass 12, using a complex apparatus of glass through which, night and day, large amounts of hydrogen cyanide are flowing. Tall columns of chemicals, totaling 65 feet in length, worked upon by vacuum pumps, make possible the separation, which depends upon the fact that the cyanide gas contains more of the heavier carbon than the sodium cyanide in water solution.

Thus it is possible to obtain sodium cyanide, a white powder, a quarter of the carbon atoms of which are mass 13. A mere pinch, a tenth of a gram, a three hundredth of an ounce, is manufactured each 24 hours, but Professor Urey's stock of the precious stuff is growing steadily until now he can display about 10 grams.

This unusual sort of carbon may very well unlock some of the secrets of life and industry. Carbon is one of the universal elements of all living things, all fuels, and almost everything else, ranking with hydrogen and oxygen. In carbon of mass 13 Professor Urey has carbon atoms that are effectively tagged or labeled. They can be distinguished from the ordinary kind. That is why they are precious.

Some of the heavy carbon will be used to discover important facts about how food is utilized in the human body. Other tagged heavy carbon atoms may be used to trace the part they play in puzzling combustion effects. This chemical pioneering promises to pay handsomely in new knowledge.—WATSON DAVIS.

TESTING TELESCOPE MIRRORS

(Copyright, 1939, by Science Service)

A NEW way of testing the accuracy of grinding for giant telescope mirrors, that saves two thirds of the cost, labor and time necessary for this vital operation, has been developed by Dr. Enrique Gaviola, astrophysicist of the National Observatory at Cordoba, Argentina. The discovery, believed one of the most important in the century in the construction of telescope mirrors, allows a parabolic surface to be ground on a great glass disk directly and tested continually during the grinding. For years astronomers have been grinding parabolic mirrors in a three-stage, tedious and costly process. From their original flat disk, as made in a glass works, they grind a spherical concave surface. Next they take another piece of glass and grind it to an optically flat surface. And finally they use the "flat" to test the spherical surface as they slowly grind and figure it into the desired parabola.

"The amount of work, time and money necessary for this three-stage operation," says Dr. Gaviola, "is about three times the amount demanded by the parabolic mirror itself. All three surfaces have to be figured, tested and corrected independently, and the optical flat has to be ground more accurately than the accuracy expected in the final parabolic mirror."

Dr. Gaviola, in a recent visit to the laboratories of the Mount Palomar Observatory, where the great 200-inch diameter mirror has been in the process of grinding since 1936, explained the methods to astronomers there. They appreciated its ingenuity but explained that they are so far advanced in their grinding, by time-tried methods, that they will continue to construct their mirror along the routine lines. At the most optimistic estimate it may be completed next year. If the method had been available and proved successful five years ago, the Mount Palomar mirror might now be in service, and the giant telescope could have been constructed at a much lower cost.

Dr. Gaviola was led to the discovery of the new method, which uses a fine wire instead of a knife edge for testing, by sheer necessity. In 1936, while at La Plata Observatory in Argentina, he set to work to correct noticeable errors in the 82-centimeter Cassegrain mirror at the observatory. "As we had no plane mirror of that size and no possibility of making either a flat or a Hindle spherical of 82-centimeter (over 2.7 feet) diameter it became necessary to find a new, simple method of testing the Cassegrain, using only the available equipment. After some experiments a satisfactory method was devised," Dr. Gaviola explains.

As described in a joint report with Ricardo Platzeck, of La Plata Observatory, to the *Journal* of the Optical Society of America, Dr. Gaviola says the new testing method works on the basic idea that to test an optical surface an arrangement is needed that will form an image of some kind. If the image is good, a study of it tells the quality of the optical surface.

If the image is not good, as it naturally will not be in a new mirror just being ground, it is subdivided into a number of good images by decomposing the main optical surface into sufficiently small parts or zones by the use of screens. The image is usually a so-called "artificial star," a bright point of light, or light from a narrow slit.

The common method is to observe the diffraction of light reflected off the telescope mirror as it passes by a sharp knife edge. The new method uses a fine wire as the diffracting object and the diffraction pattern is symmetrical on each side of it. The diffraction pattern from the various zones of the telescope mirror (secured by suitable screens with carefully cut holes in them) are observed. From these observations the curve of the mirror

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SULFANILAMIDE AND MALARIA

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HUMAN subjects as well as monkeys have been used in tests of the possible malaria-curing power of the widely used new chemical remedy, sulfanilamile, reported by Dr. L. T. Coggeshall, of the Rockefeller Foundation's International Health Division, to the American Society of Tropical Medicine meeting in Memphis.

These subjects were suffering from paresis, or general paralysis of the insane. Malaria is given such sufferers from the results of syphilis and frequently the malaria checks the mental deterioration. Some of these patients were resistant to one kind of malaria germ or parasite, *Plasmodium vivax*, but they volunteered for doses of another malaria parasite, called *Plasmodium knowlesi*, following which they were given sulfanilamide. They promptly got well of the malaria, just as did monkeys infected with the same kind of malaria parasites. This, however, apparently does not mean that sulfanilamide is a good remedy for malaria. In fact, Dr. Coggeshall stated that "when this drug was tried as a therapeutic agent against human malaria, there was no apparent effect."

The studies showed, however, that in testing any anti-malaria drug, the oxygen consumption and metabolism of the malaria germ should be taken into account. Sulfanilamide, both in monkey malaria and in test-tube experiments, was more effective against one kind of malaria parasite than against another less virulent one. The drug cured the *knowlesi* malaria in monkeys but had no effect on *Plasmodium inui* malaria. In the test-tube, similarly, it had no effect on *inui*, but markedly paralyzed the respiration or breathing of the *knowlesi* parasites.

No anti-malaria drug should be discarded, said Dr. Coggeshall, on the basis of its failure to cure one kind of malaria, but neither should the fact that it cures one kind of malaria lead to its being proclaimed as a universal remedy in malaria.

PROBLEMS OF FOREST OWNERSHIP

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AMERICA'S forest lands: should they be publicly or privately owned; should there be much or little governmental regulation? These and other questions of forest policy were discussed at the opening meeting of the Society of American Foresters in San Francisco, and diverse solutions were proposed by well-known speakers.

Outright government ownership of all forest lands, excepting only farm woodlots, was advocated by George M. Peterson, associate economist of the Giannini Foundation. Upon the initial premise that a healthy and stable nation is most surely built on distributism, that is, the private ownership of a little property by every person, Mr. Peterson developed nineteen reasons for government ownership of all large timberland areas.

Ownership of vast forest holdings by wealthy individuals or large corporations is contrary to good public policy, he stated, because such ownership does not get full value out of the forests in either felled timber, grazing, recreational uses, wildlife protection and soil conservation. Large-scale private ownership, he argued further, commonly does not give adequate fire protection and is too apt to dodge taxes and indulge in unsound financing. Better to cut this Gordian knot and go all the way for public ownership and management.

Admitting the existence of many evils in American forest economy, C. S. Martin, forester of the Western Pine Association of Portland, Ore., traced them to other causes and proposed a less drastic remedial procedure. Lack of a well-developed forest policy embracing both private and public lands is a prime cause of present troubles, Mr. Martin held, and he pointed out that even the relatively limited steps toward industrial self-regulation that have been taken in recent years have produced encouraging results, especially in fire control, reforestation, selective cutting and the adoption of sustained yield programs.

Voluntary cooperation, resulting in part from consistent education of public and industry, was seen as a potent remedy by Stephen N. Wyckoff, director of the Pacific Northwest Forest and Range Experiment Station. The viewpoints to be reconciled are the public feeling that great social values are involved in the forest policy, and the private owners' resistance to any changes that would infringe upon traditional right to do as they please with what is their own.

Mr. Wyckoff set up five premises, acceptance of which he held to be necessary if a workable "middle way" is to be found. He called for simultaneous recognition of social values and the need for profits, for management to protect these social values, for private ownership on a sustained-yield basis wherever practicable, for public payments to defray extra costs of safeguarding social values, and finally for contractual guarantees from private owners whenever they receive public aid in management of their lands. Lands that can not yield a money profit and yet have intangible values to the public, Mr. Wyckoff concluded, should be publicly owned.

REGISTER OF SCIENTIFIC MEN BY THE ROYAL SOCIETY

BRITISH scientists have been indexed and classified, but not regimented.

A voluntary register, containing upward of 80,000 names, has been prepared, giving qualifications and type of work for which the specialists are best fitted. This register was begun by the Royal Society and by various scientific and technical associations and has now been taken over and amplified by the National Service Department of the Ministry of Labor. It is available to the War Department who notify their requirements for trained personnel to appropriate committees in charge of the register. Industrialists in need of specially trained men can also apply.

THE SCIENTIFIC MONTHLY

J. McKEEN CATTELL, F. R. MOULTON and WARE CATTELL, Editors

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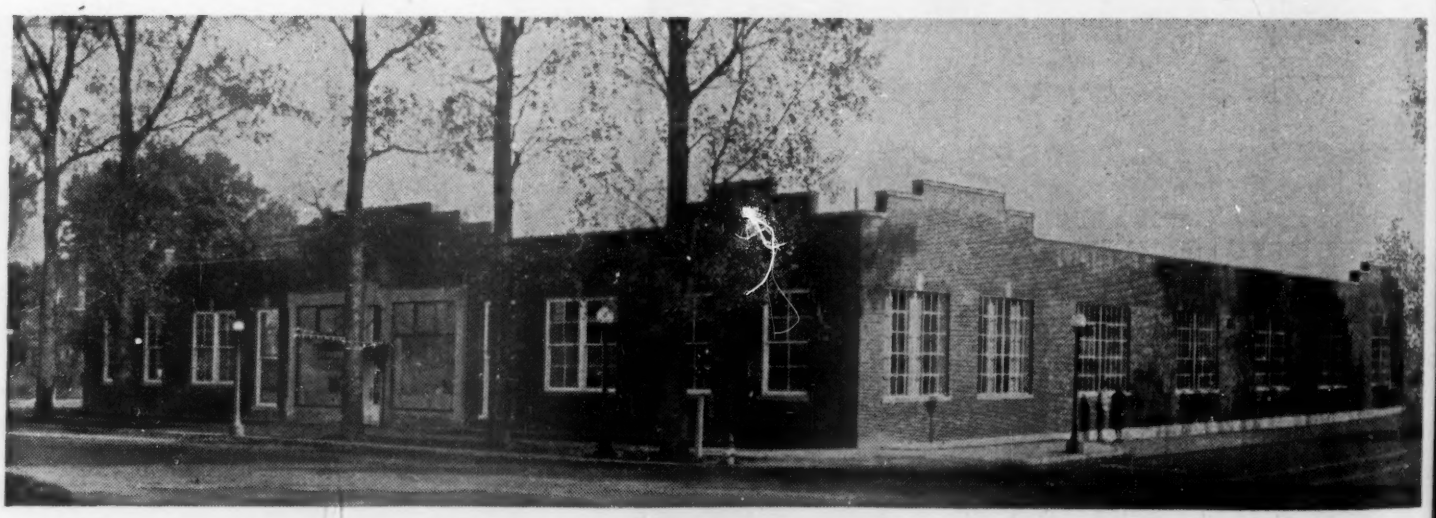

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"British science is in a very much stronger position now than in 1914, especially as regards the number of trained men," according to Professor J. C. Philip, acting head of the Imperial College of Science and Technology of the University of London and chairman of the Industrial Chemistry Section of the Central Register of Scientists.

Although there is a surplus over present requirements, nevertheless the government has decided not to repeat the mistake of 1914 when brilliant young scientists were allowed to join the fighting forces indiscriminately. Physicists still remember with regret the loss of Moseley, whose brilliant career in x-ray research was cut short at Gallipoli.

Scientists and research workers are considered to be in reserved occupations and those not engaged in war work may continue their usual activities. At the same time, while full freedom is allowed to the individual, steps have been taken to inform research workers of the type of urgent problems that await solution. Some of these are of long duration, others have arisen since the war.

The "blackout" has called for scientific development. For instance, more effective phosphorescent substances were needed for use in underground shelters. Suitable "light filters" that would allow daylight in while preventing artificial light from passing outwards are being sought. Similarly gasoline restrictions make important devices for increasing miles per gallon, and alternative types of fuel are being exploited.

The Chemical Society has formed an advisory Research Council under the chairmanship of Sir Robert Robinson, to advise research workers in universities and other research institutions concerning general war problems needing investigation.

Another set of problems, which for the time being are left to the initiative of unofficial groups like Political and Economic Planning and the Engineers' Study Group, are those likely to arise at the end of the war. Large surplus capacity for the production of light metals, explosives, etc., will exist at the end of the war, and this, as well as the workers engaged in those industries, will have to find other utilization if industrial dislocation is to be prevented.

British industry has at present a considerable reserve of trained personnel in the Germans, Austrians and Czechs who have sought refuge in Great Britain. They have so far been employed in their particular lines of work only to a slight extent. During the last war it was a "non-Aryan" chemist, Dr. Fritz Haber, who enabled Germany to fight a prolonged war by his development of a synthetic process for the manufacturing of ammonia and nitrates, essential in the manufacture of explosives. Haber died in Switzerland, an exile from Nazi Germany.

Have scientists any surprises in store in the present war? Faced with this question, Professor Philip smiled and replied: "It is not a question that I could very well answer; however, this much I can say: during the last war it was the chemist who produced some of the most unpleasant innovations, such as the use of the poisonous gases. It may be the physicists' turn now."—VICTOR HOFFMAN.

ITEMS

A NOTE on the supply of vanadium, printed under Science News in the issue of SCIENCE for October 27 describes the operations of the United States Vanadium Corporation at Uruvan, Colorado, but it is referred to as property belonging to "Vanadium Corporation of America, a subsidiary of Union Carbide and Carbon Corporation." As a matter of fact, the United States Vanadium Corporation is a unit of the Union Carbide and Carbon Corporation, and a competitor of the Vanadium Corporation of America, whose vanadium resources are in Peru.

THE number of fatal pneumonia cases in the Civilian Conservation Corps, whose members have been given anti-pneumonia vaccine, dropped this year to a rate one third that of the preceding five years. How much of this and of the reduction in total number of pneumonia cases is due to use of the vaccine can not yet be stated with certainty, according to Robert Fechner, director of the corps.

CHEMISTS of Egypt have been studying explosions which have been occurring in earthen molasses storage basins. The explosions turn the molasses into a hard carbonaceous material that makes a good fuel with properties somewhat like coke. The explosions occur between June and November when the dark-colored molasses is exposed to the hot tropical sun. Spontaneous combustion is believed to be the cause.

A TURKEY-LIKE bird with a three-inch horn growing out of its forehead, which was discovered in the jungles of Bolivia, has been announced by James Bond and Rodolphe Meyer de Schauensee, curators of birds of the Academy of Natural Sciences of Philadelphia. They call it the unicorn bird, *Pauxi unicornis* to the scientist. The bird resembles the new stream-lined Thanksgiving bird which was recently developed by the Department of Agriculture, in its size, which is about eight to ten pounds in weight. The horn which suggested its name is grayish-blue, while the feathers on the nape of the neck and back of the head are tightly curled and shiny. The new species was discovered by a collector for the academy, Mr. de Schauensee.

A MASS of bones, believed to be remains of nearly a hundred of Chief Powhatan's tribesmen, has been unearthed in an ossuary—ceremonial burial pit—beside the York River near West Point, Va. Dr. T. D. Stewart, of the Smithsonian Institution, was sent to investigate and excavate the bones, when residents notified the Smithsonian that high water had washed away the river bank, exposing human bones. The village of Chief Powhatan, father of Pocahontas, was presumably a short distance away, but Dr. Stewart reported finding no trace of it. A good deal of the shore has washed away. The burials, he said, represent an Algonquin Indian custom of digging up individual burials at stated times and re-burying them in mass, with ceremonies. Jesuit priests in Canada told of witnessing such ceremonies. Archeologists have previously found ossuaries as far south as the Potomac, but Powhatan's neighborhood represents a new southward limit for discovery of the custom.

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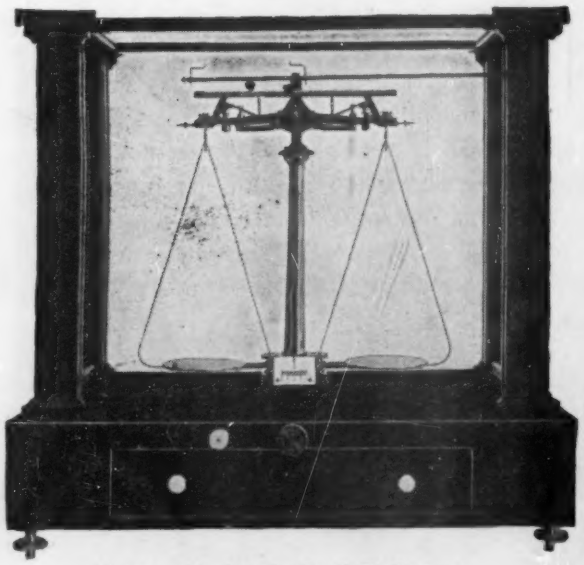

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SCIENCE NEWS

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SOCIAL SCIENCE

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DR. JULIAN HUXLEY, secretary of the Zoological Society of London, grandson of Charles Darwin's famous friend and champion, gave an address at a dinner at the Hotel Willard, Washington, D. C., on December 2.

Dr. Huxley, who will deliver one of the principal addresses before the Christmas meeting of the American Association for the Advancement of Science in Columbus, Ohio, spoke under the joint auspices of the Association, the Smithsonian Institution and *The Scientific Monthly*.

Some thinkers claim for Herbert Spencer, contemporary of Darwin and the elder Huxley, the distinction of being the first to point toward an eventual application of the findings and methods of objective science in the problems of human society, but Dr. Huxley relegated Spencer to a position analogous to that of one of the Hebrew prophets, rather than that of a direct precursor. "He demonstrated that social science was an inevitable development," Dr. Huxley stated, "but his notions of what form it would actually take and what methods it should employ were vague and essentially erroneous. Marx, on the other hand, developed a system directly based on social facts and directly applicable to them. He did not prophesy a Messiah, he indicated the Messiah. As natural scientists tend to undervalue Bacon because he himself did not make discoveries or work out experimental techniques, so social scientists tend to underrate Marx because his system is a dialectical one, ready-made and complete with answer to any problem, not sufficiently empirical and inductive for their scientific taste. It is doubtless true that, as occurred in the case of natural science, the social scientists must go their own way to work, regardless of doctrine or theoretical system; a precursor can not take the place of the Messiah or the gospel he indicates. But at least Marx, like Bacon, gave expression to a new outlook and a new method of attack, and helped materially to alter the intellectual climate so as to make it propitious for the scientific workers in his field."

To the question why social science has taken so long to emerge into large-scale operation, Dr. Huxley returned two answers. First, the method of the controlled experiment, beloved tool of natural science, is impossible when working with human society. There are no societies among lower organisms sufficiently similar to human societies to serve as experimental material; man must be his own guinea pig in social experimentation. Moreover, nothing less than the whole of society will serve: results of experiments on limited groups of people, even in the most completely regimented state, would not yield dependable answers.

The second reason for the laggard state of social science offered by Dr. Huxley is the natural reluctance of the human mind to accept multiple causes for any phenomenon. No matter how complex the behavior of a human group, we always try to find "the cause" instead of seeking for a number of causes, of a complexity comparable to the results they produce. Also, man is always the victim of his own mental slant or bias; it is practically impossible for him to divest himself of inborn and acquired prejudices.

Methods will have to be worked out, especially by the application of mathematical analysis to the problems of multiple causation, and by the use of properly adapted propaganda for the overcoming of bias.

THE CHEMICAL EXPOSITION

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"CHEMISTRY catalyzes commerce" headlines the exhibit of twenty new commercial products of chemical industry shown by the American Chemical Society at the Seventeenth Exposition of Chemical Industries in Grand Central Palace, New York, which opened on December 4.

Outstanding in interest are eleven synthetic and crystalline vitamins now available. This is the first time so large a group of these food essentials has been displayed. Included are vitamins A (carotene), B_1, B_2, B_6, C, D_2, E, K, riboflavin, nicotinic acid and ergosterol. Nine manufacturers have supplied these man-made duplications of essential body chemicals.

In the synthetic resin group are shown two new and totally synthetic fibers, Vinyon and Nylon. Hosiery and yarn made from both of these are displayed. Both are competitive with silk. Other products made from these materials include felt, filter cloth, thread, surgical sutures and fishing line.

Paint oil made from castor oil, domestically produced to compete with tung oil, and alkyd resins for making varnish from this source are also shown. Of interest in the paint and varnish industry in the American Chemical Society exhibit is a new hydrogenated rosin, "Stabelite," of superior quality as to color and resistance to light and oxidation.

Other outstanding displays include:

Rubber filter cloth, and an all glass centrifugal pump for handling corrosive liquids.

High octane aviation fuels produced by new methods.

The "threshold treatment" for economically softening hard water for boiler use.

Resins and vanillin made from the waste of sulfite paper mills, now produced commercially.

A new type of rayon from ethyl cellulose in a variety of fabrics.

New chemicals exhibited are sulfamic acid and its derivatives, a collection of seventeen new nitroparaffins and new organic compounds of phosphorus.

Twenty-six companies are cooperating with the society to supply exhibit materials and a nearly equal number of others in supplying photographs for the photo murals forming the background of the exhibit.

For botanists, agronomists, horticulturists, silviculturists, and soil scientists

GROWING PLANTS IN NUTRIENT SOLUTIONS

By WAYNE I. TURNER and VICTOR M. HENRY

Use of nutrient culture methods has enabled the scientist to determine readily the amount of the various vital elements which a plant requires for food, and the effect of these elements on the growth of that plant. For many years experiments for this purpose have been conducted in the laboratory.

This book, however, takes the subject out of the realm of pure experiment. Instead of dealing with the usual small array of plants in the laboratory, it demonstrates the practical success of nutrient culture methods in large-scale growing. It covers all the "hows" of starting and continuing nutrient culture: exact methods, formulas, photographs of actual crops and installations, working drawings of construction of efficient greenhouse layouts, sketches of actual bench construction, typical equipment needed, enough elementary chemistry, botany and plant physiology to enable the beginner at it to be successful if instructions are followed, and lists of suggested sources of equipment and materials.

Each step in the process is explained concisely and minutely. For instance, thorough instructions are given on how to determine the amounts of chemicals or fertilizers to use. Information is also given on the relation of the amount of light to the amount and kind of plant foods needed.

More and more frequently the suggestion is being heard that chemical agriculture may supplant present methods of growing. It may make possible complete emancipation from the seasons, the elimination of soil diseases, effects of drought and poor soil, shovel and wheelbarrow work. It may bring about the growing of food to a prescribed analysis.

The authors of this book are by training and experience unusually well qualified to discuss with authority both the theoretical and practical aspects of nutrient culture. Both took their college degrees in Floriculture, and the senior author, Mr. Turner, has in the last twenty years devoted himself to the commercial growing of greenhouse crops. He is well known to the trade and is recognized as one of the finest rose growers in the country. The past four years he has spent developing the practical application of nutrient culture to greenhouse crops on a large scale. At the present time he operates over 70,000 square feet in nutrients.

This book offers a lucid and practical exposition of what is being done today in the growth of plants in nutrient solutions.

Published December 6th

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A NEW ELECTRICAL MICROMETER MEASURES

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A NEW and valuable kind of electrical micrometer, which uses a special radio tube to measure distances as small as five millionths of an inch, has been developed at the U. S. Naval Research Laboratory in Washington.

Dr. Ross Gunn, physicist and superintendent of the mechanics and electricity division of the laboratory, described the instrument at the meeting in Philadelphia of the American Society of Mechanical Engineers.

The electrical micrometer is a radio tube consisting of an electron-emitting filament and two tiny plates, insulated from one another and jointly supported by a rod which goes into an elastic diaphragm fixed in the bulbous part of the radio tube. Outside the tube, and attached to the diaphragm, is spot welded another small rod whose job it is to detect tiny displacements. Slight displacements of this rod are communicated through the diaphragm into the plates of the tube, which move very slightly from their normal positions. This motion brings one plate nearer to the filament and the other plate farther away, resulting in a decided difference in flow of electrical current within the tube. Normally the current to the two plates balances and zero current is obtained. With the slight shift of plate distance current flows in an amount proportional to the displacement. This current is put through a micrometer and the deflection of the needle of this instrument is a measure of original microscopic displacements.

Dr. Gunn stressed the compactness and stability of the new device as well as its great versatility to a variety of measurements. The electrical micrometer can be used to measure displacements at remote points, and these displacements may be due to tension, compression or torsion.

By attaching a small mass to the external detecting arm of the tube it can be converted into an accelerometer. By the use of elastic bellows fluid pressures can be measured. By using large calibrated proving rings, its range of measurement can be enlarged indefinitely and it has proved useful as an accessory to limit and tolerance gauges. Because it is able to follow vibrations up to 200 cycles a second it can be attached to an oscillograph and thus produce a visual pattern comparable to the motions of the tiny detecting rod.

SOLAR RADIATION AND THE WEATHER

(Copyright, 1939, by Science Service)

POSSIBILITY of statistical error in the theory that there are significant periodic changes in the sun's radiation which predictably affect the earth's weather has been eliminated by a Harvard mathematician.

The findings, made by Dr. Theodore E. Sterne, lecturer on astrophysics at Harvard University, are believed to eliminate one of the major objections raised against the solar radiation-weather theory advanced by Dr. Charles G. Abbot, secretary of the Smithsonian Institution.

Dr. Abbot's deductions, based on years of solar radiation observations at stations spotted throughout the world, have been questioned as due to either statistical errors in analyzing the data or systematic errors of observation. The Harvard research removes this first objection.

In his findings, Dr. Abbot discovered evidence for changes in solar radiation in periods of 7, 8, 9¾, 11, 21, 25, 34, 39½, 46 and 68 months. Dr. Sterne believes that three of these periods may be due to statistical error—those of 7 months, 8 months and 34 months.

The other seven periods, Dr. Sterne has found, are not attributable to this and he has gone so far as to say that the odds against these seven periods being purely statistical error are about 30,000 to one, or even higher, running in some cases into the millions. He emphasized that his studies were concerned purely with the statistics of Dr. Abbot's researches and not at all with the question of observational technique.

The periods in question were worked out by Dr. Abbot during the fifteen years from 1920 to 1934 and are built on the average of solar radiation in many parts of the world three times each month. Dr. Abbot measured the amount of radiation received in calories per minute per square centimeter at right angles to the sun. The average during this 15-year period, he found, was 1.94 calories per square centimeter per minute.

THE AUTOGIRO

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THE important research finding, that autogiros with their whirling rotor blades have more inherent longitudinal stability (ability to react against a pitching motion in flight) than do normal airplanes, was announced at the concluding meeting in Philadelphia of the Philadelphia chapter of the Institute of Aeronautical Sciences by Professor Alexander Klemin, of New York University, in a scientific report with Lieutenant Victor Haugen, U. S. Army Air Corps, and S. B. Sherwin, first holder of the newly created Cierva Memorial Fellowship at New York University.

The new report contradicts some previous wind tunnel experiments and is in accordance with practical experience. The theoretical investigations show that the rotor with its flapping hinge placed at some distance from the center of rotation is definitely stable. In this the rotor is superior to the airplane wing, which has no inherent stability of its own.

The investigations also show that as the rotor is placed above the center of gravity of the machine with its axis of rotation somewhat behind the center of gravity, the autogiro will be stable without the intervention of the horizontal tail surfaces. Such inherent stability without horizontal tail action is impossible in the airplane. Furthermore, rotors of the direct control type are pivoted at a suitable point so that not only is it possible to secure longitudinal control without use of an elevator, but the rotor tends to change its inclination so as to increase stability. In the airplane, flying with free stick, the stability is less than flying with stick held in a fixed position. In the autogiro with pivoted rotor, on the other hand, there is a dual stabilizing effect. Thus from the point of view of horizontal static stability, the autogiro has distinct points of superiority over the airplane. To

move the discrepancy existing between wind tunnel data and theoretical and practical reasoning, Lieutenant Haugen will conduct an investigation into the stability of the rotor with offset hinge, systematically varying the position of the hinge.

One of the most interesting problems in the helicopter to-day is whether super-imposed air screws, as in the Breguet helicopter, or air screw placed on either side of the fusilage, as in the Focke helicopter, are more efficient. Mr. Sherwin has devised a special apparatus for investigating this point in the nine-foot wind tunnel of the Daniel Guggenheim School of Aeronautics of New York University.

CHEMICALLY INDUCED PLANT TUMORS

CLUES to the mechanism of cancer production in man and other animals are now being sought in the plant world. Latest efforts to produce cancers in plants by the chemicals in tar which produce cancer in animals or by other chemicals were described by Dr. Michael Levine, Montefiore Hospital Biological Laboratory for Cancer Research, at a meeting of the Torrey Botanical Club in New York on December 5. Montefiore Hospital is the only hospital in the world which has a garden devoted to plant cancer studies.

Crown gall, the form of cancer which plants are known to harbor, is not analogous to human or other animal cancer, Dr. Levine said. Cancer-causing hydrocarbons, which produce cancer in animals, poison plants but fail to produce cancers in them. Certain other irritating chemicals, such as indole acetic acid, indole butyric acid, naphthalene acetic acid and a series of scarlet red dyes, when applied to the injured surface of a plant, produce roots together with small tumors. These tumors, however, are not, in Dr. Levine's opinion, analogous to human or other animal tumors, either. The plant tumor, he believes, is a part of a reparative and protective mechanism of the plant, analogous to inflammation in animals.

Dr. Levine expressed the hope that plants ultimately will be made to form tumors as a response to chemical substances. He implies that the plant cells will be so modified as to proliferate without limit, endowing them with the property now possessed by animal cancer. The production of malignant plant growths will throw light on the mechanism of cancer production in animals. The absence of blood and lymph streams and lack of diversity of tissue types make the plant a suitable subject for the study of this important problem.

ITEMS

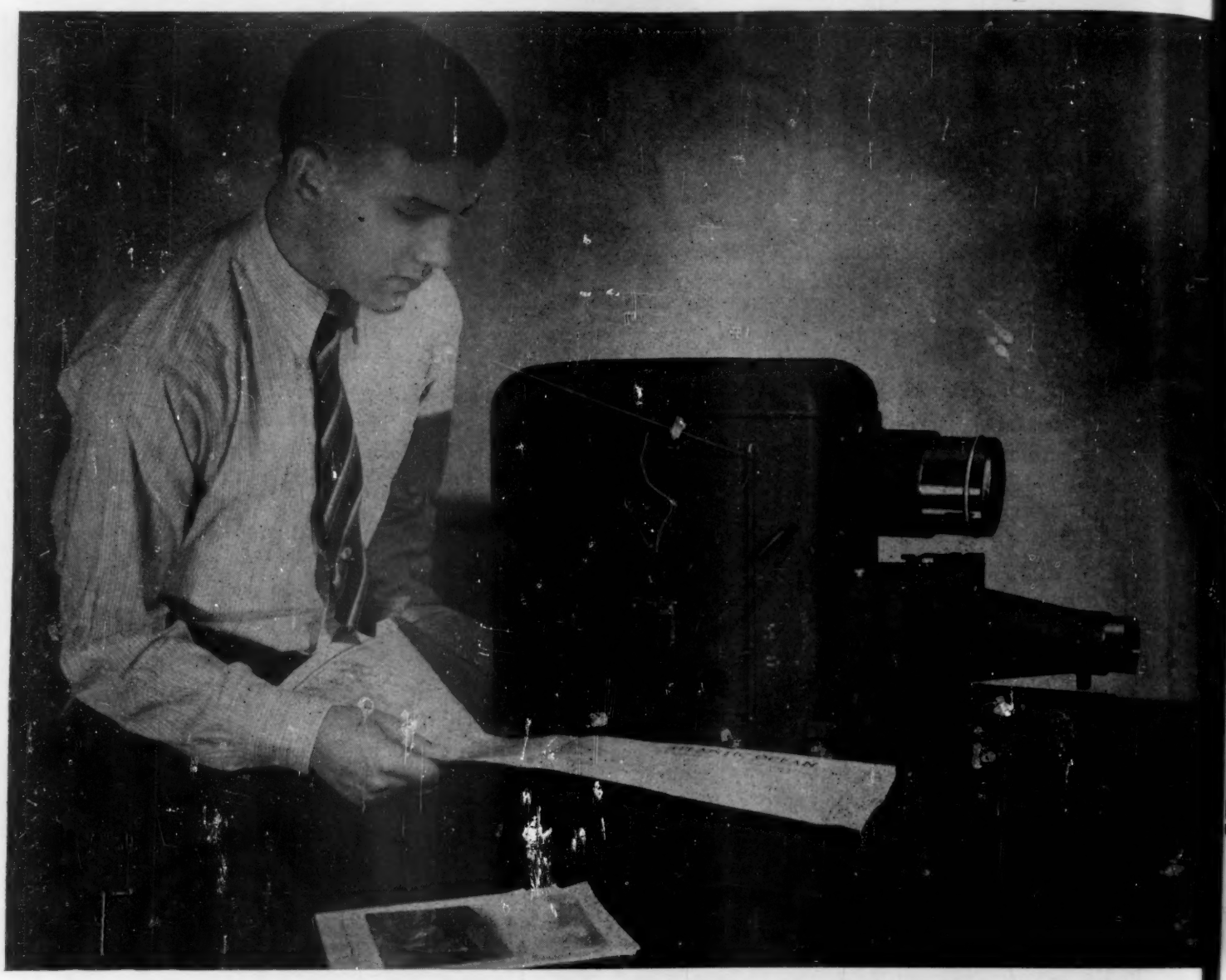
DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, pointed out at the seventy-fifth anniversary dinner of the Columbia University School of Engineering that the applications of scientific knowledge advance much more rapidly than the mere increase of knowledge. "There are two factors which account for the increasing rapidity in the development of new applications of science to human welfare," Dr. Compton said. "One of these is simply the fact that we are learning continually by experience how to make these applications more quickly and effectively. The second is that the possibilities for accomplishing our purposes increase somewhat as the square of the amount of knowledge which we possess." Thus if knowledge can be doubled in extent the applications can be increased four-fold.

How a four-lane highway was "jacked" apart to make a divided roadway and thus reduced fatal accidents over 83 per cent. was described at the meeting at Washington, D. C., of the Highway Research Board of the National Research Council by Arnold H. Vey, traffic engineer of the State of New Jersey. New Jersey took a popular four-lane highway and split it down the middle, jacking up separate concrete slabs and moving them sideways. Two roadways, separated by a dividing center strip, thus resulted. A study of accident figures on this road in 1933–34, before the division, and for 1937–38, after the division, showed that fatal accidents dropped 83.3 per cent. Non-fatal accidents decreased 48.5 per cent., and accidents involving property damage were cut 17.6 per cent. The reduction for accidents of all kinds was 40.4 per cent. Particularly valuable was the new divided highway at night, for accidents were then decreased by 47.2 per cent., while during the day they dropped only 31.4 per cent.

THE giant 608,170-pound locomotive, "American Railroads," which millions saw at the New York World's Fair, was the outstanding development of railroading for 1939, according to a report submitted to the meeting in Philadelphia of the American Society of Mechanical Engineers by its subcommittee. "American Railroads," while it stayed in one place, covered thousands of miles on rollers to thrill World's Fair crowds. Designed to haul 1,200-ton trains at speeds up to 100 miles per hour, it was the cooperative undertaking of the Baldwin, American and Lima locomotive companies.

ROTARY winged aircraft of the autogiro or helicopter type will usher in the third stage of growth in man's conquest of the air, according to Igor I. Sikorsky, pilot and designer, who spoke at the meeting of the Philadelphia chapter of the Institute of Aeronautical Sciences. Mr. Sikorsky forecast a brilliant future for planes with rotary wings, particularly in the field of private flying, to add to lighter-than-air and heavier-than-air transportation, the two earliest stages of man's aerial transport. By rotary wings, Mr. Sikorsky said, private flying can come into its own, for planes of this type overcome the main handicap of private flying to-day, which is lack of ability to take off and land in small spaces. It is this handicap, he feels, rather than lack of speed, lack of safety or even high cost of operation which has limited private aviation.

PLAIN ordinary water is now being used successfully as a lubricant for bearings in giant steel mill rolls and large ship propeller shafts through advances in the plastics industry, L. M. Tichvinsky, of the Westinghouse Research Laboratories, pointed out at the meeting of the American Society of Mechanical Engineers. Woven textile fabrics are impregnated with an organic binder and then treated by temperature and pressure to create these bearings, which require no oil or grease but perform efficiently when lubricated with water, which serves both as a cooling agent and as a lubricant.



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The vols. of *Osiris* will contain, in general, series of articles devoted to a single subject, and also longer memoirs. It is proposed to publish one volume a year, or exceptionally two, but not more.

Isis will continue to be a quarterly journal containing shorter articles, reviews, notes and correspondence and critical bibliographies. The removal of the longer articles to *Osiris* will increase the variety and attractiveness of *Isis*.

SCIENCE NEWS

Science Service, Washington, D. C.

SUPER-HEAVYWEIGHT STARS

(Copyright, 1939, by Science Service)

THREE new super-heavyweights among stars, so solid that each cubic inch of their substance weighs not pounds but tons, are the latest discoveries made by Dr. G. P. Kuiper, using giant telescopes of McDonald Observatory at Fort Davis, Texas, and Yerkes Observatory at Williams Bay, Wis.

Known as white dwarfs, the newly found heavyweights are called Wolf 1516, the primary of the wide double star Wolf 672, Ross 640. This brings the number of white dwarfs known to 22, all stars relatively near the earth. Wolf 1516 is believed to have a diameter about four tenths that of the earth and such dense material that it weighs between 500 and 1,000 tons (1,000,000 and 2,000,000 pounds) per cubic inch. It has, however, not yet had its size and weight precisely determined, but it resembles an older one, A.C. 70 degrees 8247, that does have this amazing super-weight.

These two stars are the hottest white dwarfs known, with surface temperatures of over 30,000 degrees Centigrade. Only two other white dwarf stars, Wolf 457 and Wolf 219, are known to be similar to these stars. They are possibly even slightly heavier, at most about double in density. The other two new white dwarfs are probably less extreme. Dr. Kuiper has not yet finished his studies of them. Two other stars, Ross 22 and Wolf 923, are suspected of belonging to the same class and are also being investigated further.

More than half of all the white dwarfs known, 13 out of the 22, have a weight nearly the same as the famous companion of Sirius, about 3 tons per cubic inch, while the rest of them are heavier.

These very dense stars may be the result of a great stellar explosion, causing a collapse of a more ordinary star into smaller space. One idea is that they consist of stripped atoms, deprived of their electrons.

A QUANTUM WORLD

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AN amazing quantum world, where all elephants seem to have fur, where a tiger appears not as one animal but a whole group, and where a machine gun instead of a rifle would be needed to kill one of them, was described by Professor George Gamow, of the George Washington University, speaking before the Philosophical Society of Washington.

You could enter the quantum world if you could shrink down smaller than did Alice in Wonderland and become the size of an atom. Or you could do it, as did Professor Gamow, by increasing the magnitude of the quantum constant (which determines the uncertainty in position and motion of objects) so that it would have a noticeable effect on large objects.

If you went tiger-hunting in a quantum jungle, Professor Gamow explains, the elephant on which you would ride would appear to be covered with fur. This would only be the uncertainty in the size of the elephant, so that it appeared to have a fuzzy, furry outline.

The tiger for which you are searching would be the most baffling sort of animal. Instead of a single beast, it would entirely surround your elephant. To try and shoot it with a rifle by careful aiming would be useless. The chances would be many thousand to one that you would miss it. All you could do would be to use a machine gun and spray the landscape in the general direction of the "multiple" tiger. Eventually, and only by chance, would a bullet finally hit the tiger and finally kill it by direct impact.

Fantastic and imaginary as is Professor Gamow's tiger hunt, the happenings are similar to those which physicists now believe exist in the tiny world of an atom where individual particles are so minute that the quantum constant, determining the uncertainty of position, is a very real problem.

In experimental atomic physics the elephant corresponds to the heavy nuclei of atoms and the "multiple" tiger to the fuzzy, indeterminate position of an electron about the nucleus. The machine gun technique of hitting the "tiger" corresponds to attempts to bombard atoms in transmutation experiments where whole hosts of particle "bullets" must be fired in order to make a single hit.—ROBERT D. POTTER.

ULTRA-VIOLET AND INFRA-RED RADIATIONS

ULTRA-VIOLET and infra-red radiation can have many uses on the electrified farm of the future, if only current becomes cheap enough and suitable equipment is developed, according to L. C. Porter, of the General Electric Company's incandescent lamp department in Cleveland, who spoke at the Chicago meeting of the American Society of Agricultural Engineers.

Infra-red rays are best known for their heating effects, Mr. Porter stated. Adaptations of the familiar dull-red-glowing electric heaters can readily be made for use in poultry houses, in barns to keep newborn animals warm and in the quick drying of hay. If their operation can be made cheap enough, their greater compactness and less fire risk will give them considerable advantage over present types of equipment.

Ultra-violet rays are known to have certain well-marked physiological effects, as in activating sterols to produce vitamin D and in keeping in check plants' growth in length. For producing well-proportioned plants in greenhouses, Mr. Porter suggested the use of a new kind of incandescent lamp, which has a globe permeable to ultra-violet as well as to visible rays. With these and other lamps in proper proportions, he stated, a close approximation to natural sunlight can be obtained, with control of duration and intensity not possible under natural conditions.

The well-known germicidal effects of ultra-violet rays still await a number of possible practical applications on the farm, Mr. Porter pointed out. They may be used in stables and dairy buildings as they now are in hospitals,

to keep down the germ population of the air. They may be called on to control the spread of epidemics among farm animals, and to check the growth of molds and other fungi on hay, grain and other products. Their fluorescent effects may aid in diagnosing animal diseases and in examining vegetables and fruits.

With Dr. L. J. Buttolph, physicist of the General Electric Company, Mr. Porter will publish some of his suggestions in the forthcoming issue of *Agricultural Engineering*.

THE DISCOVERY OF NEW OIL IN NEBRASKA

(*Copyright, 1939, by Science Service*)

To the successful discovery of oil in Michigan and in Illinois can be credited the new discovery of petroleum in Nebraska at Falls City, near the Kansas border, according to a report of the U. S. Bureau of Mines.

The petroleum finds in Michigan and Illinois were based on geologic "basins" which look like some giant dinner platter with a corrugated bottom. Overlying the basin is surface material—in the case of Michigan, glacial drift—so that the ground level over the drift is not by itself indicative of the underlying depression in rock strata.

The new Nebraska finds have been based on two years of exploration of the Forest City basin, an area comparable to, though smaller than, the Michigan basin.

A typical procedure of geologists in searching for petroleum in a basin area is to follow "trends," the lines of the corrugations. A network of these corrugations is worked out and wells drilled at the intersections of the trend lines.

Production in the first Nebraska well is small, and it appears that the operators will have to push the well greatly to get sufficient oil to win the $15,000 prize offered by the state legislature for the first well which will produce 50 barrels daily for 60 days. In much greater production is the Mississippi discovery of oil, also recently reported, in Yazoo County. Over 700 drilling permits have been issued, but the possible extent of this field has not yet been determined.—ROBERT D. POTTER.

THE TREATMENT OF SYPHILIS

A NEW syphilis medicine, which can be taken in pills, has been developed by Dr. Paul J. Hanzlik and his assistants at the School of Medicine of Stanford University.

Success with exacting trials of the drug for over four years, in syphilis clinics in San Francisco and in Los Angeles, Cleveland and Philadelphia, has been reported. The council on pharmacy and chemistry of the American Medical Association in Chicago has accepted the new medicine as an anti-syphilitic agent.

Sobisminol is the name of the drug. It is a bismuth compound. Its great advantage is that it can be taken in pills, or capsules, at home, thus cutting down the number of visits to clinic or doctor's office and, of course, making unnecessary the hypodermic injections of bismuth which have been part of syphilis treatment.

The new medicine, however, is not a short-cut to a syphilis cure. It must be taken in combination with injections of arsphenamine or one of the other arsenical compounds. The total course of treatment still takes nearly two years, made up of alternating periods of six to 10 weeks of weekly arsphenamine injections and 10 to 20 weeks of taking the sobisminol capsules.

The new medicine will be sold on a physician's prescription only. Bismuth, the active ingredient, is a poison which is not safe for patients to prescribe for themselves. The new medicine is protected by patent held by Stanford University and the licensing agreements already made with three drug manufacturing firms restrict the sale of the drug without prescription and also forbid its exploitation to laymen by newspaper advertising, radio or window displays. Royalties will be used for further research in syphilis and related problems.

Sobisminol is said to produce prompt healing of syphilitic lesions and to have a killing effect on syphilis germs in the blood and tissues. Because of its ability to penetrate the brain and nervous system, it has been found to bring relief from pain in a high percentage of cases in the late stages of neurosyphilis. One physician who used it in treating patients reported that if used early in syphilis it "may prove to be of value in the prevention of neurosyphilis," the terribly destructive late stage in which the disease attacks the brain. The preventive action of the new medicine, however, can not be determined conclusively at this time, because neurosyphilis generally does not appear until 10 or 15 years after the first infection.

The production of a bismuth compound for oral treatment involved making a hypothetical chemical compound which had never been actually manufactured. This is triisopropanolamine, which is combined with sodium bismuthate and propylene glycol to make a bismuth compound that can be absorbed from the stomach into the blood, which is stable enough to withstand chemical action in the digestive system, and which prevents heat coagulation of the blood.

A NEW TREATMENT FOR PNEUMONIA

(*Copyright, 1939, by Science Service*)

A NEW chemical treatment for pneumonia, using a new drug, sulfathiazole, has been announced.

Physicians who tested it experimentally on human patients pronounce it even better than sulfapyridine, widely hailed in recent months as the chemical conqueror of pneumonia. The new drug is safer than sulfapyridine, and it does not make the patients sick. Nausea and vomiting, which have been a distressing feature of sulfapyridine treatment, are practically absent when sulfathiazole is given.

Developed in the Squibb Institute for Medical Research by Drs. H. B. van Dyke, R. O. Greep, Geoffrey Rake and C. M. McKee, the first report of the new drug is being published in the current issue of the *Proceedings* of the Society of Experimental Biology and Medicine.

Laboratory experiments on hundreds of mice show that the toxicity of sulfathiazole is much less than the toxicity of sulfapyridine except in doses far larger than are needed to cure pneumonia. In the body sulfapyridine is rather rapidly combined or conjugated with acetic acid. This unfortunately makes the drug quite inert and unless in its effect on the infection, only the uncombined form being active. The new drug, sulfathiazole, however, is

combined with acetic acid to a much smaller extent, so that most of the drug given is effective until it is excreted. This means that doctors do not have to give as much sulfathiazole to treat a pneumonia patient. Chronic poisonous effects from accumulation of the drug in the body are much less apt to occur because sulfathiazole is excreted more rapidly than sulfapyridine.

Sulfathiazole is chemically related to sulfapyridine and sulfanilamide. It was prepared by several groups of scientists in the search for better chemicals with which to fight infections that threaten human life. The drug is given by mouth. In the mouse studies it had to be mixed with the food in order to make sure that all the drug given was being absorbed, so that comparisons between sulfapyridine-treated and sulfathiazole-treated animals would be on an exactly equal basis. For treatment of pneumonia patients, it is not necessary to mix the drug with the food.

TRACHOMA ERADICATION

SULFANILAMIDE treatment of the blinding eye disease, trachoma, among American Indians has been so successful during its first year's trial that the Indian Service will launch a trachoma-eradication program next year.

Announcement of the success of the sulfanilamide treatment and of plans for a sharply expanded program, which it is hoped will bring this ancient scourge under control, was made by U. S. Commissioner of Indian Affairs John Collier in his report to Secretary of the Interior Harold L. Ickes.

The success of the new treatment will probably lead to its adoption in foreign countries, where trachoma is even more of a problem than it is here. Dr. R. Siri, a Siamese physician now in this country on a Rockefeller grant, plans to study the treatment on Indian reservations in the West before leaving for Siam in January. Out of Siam's population of 15,000,000, it is estimated that 3,000,000 persons are afflicted with trachoma.

Mr. Collier states that the disease has been eliminated completely by sulfanilamide treatment among the school children at Fort Apache, and trachoma in older Apaches is being rapidly cleared up. Of the more than 1,000 trachoma-afflicted Indians treated with sulfanilamide so far, 60 per cent. have improved to the point where physicians state the disease is "arrested." Since trachoma is caused by a germ and is largely limited to Indians in this country, it is believed that by arresting the disease in all patients, the spread of this eyesight-destroying scourge may be stopped. This would mean practical eradication of the disease. Quarantine regulations check its importation from foreign countries.

Sulfapyridine will be tried as well as sulfanilamide, according to Dr. J. G. Townsend, head of the Indian health service. The service is trying to determine which drug and what dosage will be most effective in arresting trachoma with greatest speed at least cost. One difficulty of the new treatment is in getting the Indians to take the medicine. Sulfanilamide is given them in the form of pills, and many of them can not understand why a pill should relieve an eye ailment. Nurses have found they must examine the children's mouths to be sure they swallow the pills.

Difficulty in checking trachoma in the past has been partly due to lack of sanitary facilities among the Indians. Many Navajos, Dr. Townsend pointed out, have to carry all their water, for drinking as well as washing, six or seven miles. Under such conditions, instructions about washing and the use of individual clean towels to prevent spread of germs are not too likely to be carried out.

ITEMS

How America's flyers of to-morrow will be selected and trained was told by Dr. Dean R. Brimhall, assistant to the chairman of the Civil Aeronautics Authority, speaking as guest on Science Service's Adventures in Science program on Monday, December 11. A committee of nationally known psychologists is cooperating with Dr. Brimhall and the CAA in this work. Just as during the World War psychological tests were used to pick the proper jobs for soldiers, so in this new aviation activity psychology and other scientific methods are to be used in making the training most effective.

SEVEN billion or more young fish and eggs of four important commercial species—cod, haddock, pollock and flounder—have been planted in favorable spots along the North Atlantic coast of this country by the U. S. Bureau of Fisheries during the past year. The work was carried out by three marine hatcheries of the bureau in New England. The states of Maine and Massachusetts are also cooperating toward the repopulation of their offshore waters with lobsters.

A GREAT mass of living coral has been brought to St. Augustine, Fla., for the Marineland Studios by the fishing vessel *Porpoise*, which was fitted with a specially constructed well for the purpose. The coral tree was broken off its base, on the reefs near Walker City, Bahamas, and transferred into the ship without exposure to the air. Previous attempts to transfer living coral into aquaria have all ended in failure because even brief exposure to the air proved immediately fatal to the thousands of small polyp animals.

COTTON linings for irrigation ditches may be the new way to make a dent in the surplus cotton stock piles of the South, it was suggested to the National Reclamation Association meeting at Denver. The new utilization of cotton supplements the use of cotton fabrics as a binder for secondary highways and airport runways. W. H. Robinson, manager of an irrigation district in Idaho, described how a section of an irrigation canal was lined with a mixture of asphalt and gravel backed by heavy cotton fabric. Water losses in this section, which formerly ran from 20 per cent. to 30 per cent., have now been cut to about one and one half per cent. The standard method of lining irrigation canals is with concrete, which pays for itself despite high cost. The cotton-gravel-asphalt liner is cheaper.

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By **NEIL E. GORDON**, *Professor of Chemistry, Central College; formerly Professor of Chemical Education, The Johns Hopkins University;* and **WILLIAM E. TROUT, JR.**, *Professor of Chemistry, Mary Baldwin College.*

This volume offers an unusual integration of text, laboratory manual and workbook. Directions for experiments are given, with blanks for the student's records. The arrangement does not preclude the use of a separate notebook. Principles are stressed, rather than applications.

Ready in January Second edition; 753 pages; 159 illus.; 6 by 9; $3.50

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SCIENCE NEWS

Science Service, Washington, D. C.

SCIENCE IN 1939

MATHEMATICS

A NEW generalization of the length of a curve made it possible in 1939 to determine the "length" of very general sets of points in a plane. Properties of several important subsets of well-known function spaces were studied.

Progress on the famous continuum problem, which concerns infinite numbers and whether there is any infinite number substantially smaller than the number of points on a line and substantially larger than the number of whole numbers, showed that there is no inconsistency in assuming that no such number exists, although it has not been proved that there is no such intermediate number.

The ergodic theorem was extended on the one hand to the study of homogeneous chaos; on the other hand, to the problems of diffusion gases, hydrodynamics and statistical mechanics.

The mathematical theory of the change in temperatures occurring in a non-homogeneous bar with discontinuous initial temperatures was studied.

Properties of very general spaces were investigated by means of related configurations called "gratings."

An application of elegant modern methods for elliptic functions and fields to the study of the more general Abelian fields was outstanding in abstract algebra.

CHEMISTRY AND PHYSICS

ATOMIC energy was released in 1939 by the splitting of uranium atoms under neutron bombardment. Originally discovered in Germany, uranium fission was quickly confirmed in America and elsewhere. Experiments indicated that for each uranium atom split there was released 175,000,000 electron volts of energy.

Thorium and protactinium were likewise found to split and release their atomic energy.

The fission of uranium was found to be accompanied by the emission of other neutrons in a delayed reaction which may be the link in a chain reaction that potentially would make possible the practical release of uranium's atomic energy.

Barium, krypton, antimony, tellurium, iodine, strontium, yttrium, lanthanum, xenon, caesium and rubidium are among the elements found to be created by the splitting of uranium with the release of large amounts of energy.

Experiments showed that the work of extracting an electron from tungsten (electronic work function) which usually is assumed to be a constant in classical theory actually varies with temperature amounting to an increase in energy of .00006 electron-volts for every increase of one degree Centigrade.

A new type of chemical reaction obeying the laws of chance and operating between compounds hitherto believed to be inert to one another, as cream and milk, was discovered.

The most sensitive current detecting device ever created was developed which can detect .000,000,000,000,000,000,-001 amperes, or a current equal to a single electron passing down a wire every five minutes.

Density, temperature and other important facts about the atmosphere up to heights of 24.8 miles were determined by use of a flickering searchlight beam and photoelectric cell detectors.

The world's most powerful continuous magnetic field, with a strength of 100,000 gauss, was created.

An improved and simple way of producing thiodiglycol, starting material in the manufacture of mustard gas, was developed.

Hydrogen fluoride was discovered to be an excellent catalyst for many vital organic chemical reactions, improving the yield of many reactions and making possible some which have not previously been attained.

A new synthetic silk-like fiber made from polyvinyl acetal resin, and known as Vinyon, approached commercial production.

Optical glass having the highest index of refraction (light-bending ability) and the lowest dispersion ever attained was patented.

The speed of light, fundamental physical constant, was determined for the first time by a completely automatic method that makes the observations independent of the observer.

ASTRONOMY

THE McDonald Observatory 82-inch telescope, second largest in the world, was put into use in 1939 on Mount Locke, Texas.

Television apparatus was devised to detect activity in the sun's corona without waiting for total eclipse, promising aid to forecasts of disruptions in intercontinental radio communication.

An unusual number of comets, 6 new and 7 returns of periodic comets found in previous years, were discovered: Kosik-Peltier, periodic Pons-Winnecke, Vaisala, Jurlof-Achmarof-Hassel, which came to naked eye brilliance, periodic Kopff, periodic Schwassmann-Wachmann, periodic Brooks II, Rigollet, Kaminsky, periodic Tuttle, periodic Giacobini-Zinner, Friend, periodic Faye.

Five more supernovae, tremendous super-exploding stars, were discovered in distant nebulae; occurrence of three such recent outbursts in one nebula within 16 years suggested that in some galaxies a tenth of the stars may explode in a time equivalent to the period since the earth's rocks cooled.

Solar activity remained at a high level during the year with sun-spots totaling more than 200 on many days; auroral displays of unusual intensity and interference with long distance radio communication.

Mars made the closest approach to the earth in 15 years; Jupiter came nearer the earth than in 24 years, Saturn came closer to earth than in 20 years.

Two more extremely dense "white dwarf" stars, one with a weight of 9,000 tons per cubic inch, were the first discoveries made with the new McDonald Observatory telescope.

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EARTH SCIENCES

A GOVERNMENT-SPONSORED American expedition to Antarctica set sail in 1939, equipped with planes and a specially built snow cruiser, to amass geologic, geographic and oceanographic data and collect zoological specimens and information.

A new method was developed for obtaining geologic data on the deep bottom of the ocean by means of TNT explosions.

A new type of "robot" unmanned observatory made possible the obtaining of weather data in remote and inaccessible places, like exposed mountain tops and the polar regions.

The U. S. Weather Bureau made two innovations: "breakfast time" radio broadcasts and combination aviation and general forecasts made at airfields.

A large iron meteorite was found in Modoc County, Calif.

There were more than 35 earthquakes of sufficient severity to be registered on the world-wide network of seismograph instruments.

After a nearly normal summer, an unprecedented autumn drought gripped most of the country.

The North Atlantic iceberg season was the longest on record.

The first submarine charts of the eastern coast showing depths out to some 10,000 feet with all sounding incorporated in submarine contours were issued.

A submarine peak, rising nearly two miles above the ocean bottom, was discovered in the Gulf of Alaska.

A new "deepest spot" for the Atlantic, 5.7 miles, was found in the Nares Deep, north of Puerto Rico.

BIOLOGICAL SCIENCES

ONE of the big biological events of the century was the discovery, off the eastern coast of South Africa, of a large, deep-sea fish belonging to a group supposedly extinct since the days of the dinosaurs. The scaly monster, about five feet long and having huge blue eyes, has been given the scientific name *Latimeria chalumnae*.

Two human embryos, only eleven days old, were studied.

Light, either artificial or from the sun, serves to increase the ability of plants to withstand midsummer heat, experiments showed.

Undifferentiated plant tissue was induced to grow indefinitely in test-tubes.

A new genus of palm found on Cocos Island was named *Rooseveltia frankliniana* in honor of the President.

Oxygen requirement of a fertilized mammalian egg was found to be 0.00073 cu mm per hour.

A new method was devised for measuring soil moisture, by passing electric current through a buried block of gypsum.

A chemical necessary for the capture of carbon dioxide in food formation by plants was found.

Seedless watermelons were produced by chemical treatment of unpollinated flowers.

A plant growth-retarding substance was discovered.

A substance that makes plant wounds heal was discovered and named traumatic acid.

Legs were successfully cross-transplanted among embryos of chickens, turkeys and other fowl.

Colchicine was extensively applied in the breeding of new varieties of plants.

A new type of rubber cavity-filling for tree wounds was designed to provide an inexpensive treatment.

A new cooperative system for artificially inseminating cows, ewes and other farm animals was inaugurated in several states.

ANTHROPOLOGY AND ARCHEOLOGY

AT Tanis, entering the tomb of Pharaoh Shishak I, plunderer of Solomon's Temple in Jerusalem, archeologists found the place undisturbed and the Pharaoh enclosed in silver and gold coffins. First discovery of Neanderthal Man in Central Asia was reported in 1939, the skeleton of an eight-year-old boy, unearthed near Tashkent, Turkestan.

The oldest known dated monument in America, the equivalent of 291 B.C. by one correlation, 31 B.C. by another, was discovered in Tres Zapotes, Mexico.

Nestor's Palace of Odyssey fame was found on the Promontory of Pylos, and in the ruins lay hundreds of archives in Cretan-like script.

The impressive ship grave of an Anglo-Saxon king, probably Redwald, who died about 620 A.D., came to light in Suffolk.

Measurements of 147,000 American children provided the clothing industry with its first scientific basis for sizing children's clothes.

Hailed as a new and important link between man and ape, a distinctive fossil tooth found at Sterkfontein, South Africa, was believed allied to remains of the man-ape of 50,000 to 100,000 years antiquity previously found in the same district.

An extraordinarily well-preserved Neanderthal skull with well-developed brain capacity was unearthed on the west coast of Italy.

Seven skeletons of "modern mankind" which had been found in the cave of Peking Man, China, were scientifically described and pronounced surprisingly varied with the inclusion of Indian-like types.

A village unearthed in Arctic Alaska revealed a form of prehistoric Eskimo life quite different from anything previously seen.

Beads and additional types of tools were found at the only known camp of Folsom Man in Colorado, clarifying the picture of earliest Americans as equal in culture to Stone Age Europeans of the same era.

Tree-ring technique of dating pueblo ruins in America was reported applicable to certain Viking and pre-Viking sites in Scandinavia; also to New England sites.

Life of refugees when Crete's civilization fell about 1100 B.C. was shown by excavation of a city of refuge on Mount Karphi, Crete.

Exploration of a royal chamber tomb of the Mycenaean

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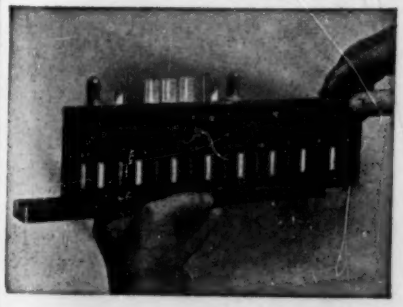

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age in Athens showed that before the Trojan War era that city was rich and important.

Psychology and Psychiatry

THREAT of European conflict and its reality stimulated research on the mental causes leading to war, effects of propaganda and war on the minds of belligerent and neutral peoples and means of protection from its influence.

Dentists, artists, engineers and teachers, not clergymen, church members, lawyers or domestic servants, were found to be more numerous in the cities rating highest in "general goodness of life."

Use of strychnine to vary the pattern of brain waves from the sensory cortex made possible the mapping of that area which was found to be very large with major subdivisions serving sensation in the face, arms and legs separately.

Idea of a strictly localized speech center in the brain came into further question when it was observed that some patients recover after loss of speech through brain injury.

The drug curare was found to depress the brain cortex or that part of the higher nervous system between the cortex and the spine so that learning can take place only through sub-cortical parts of the nervous system, explaining ability of the drug to produce "dual personality."

A special fund of more than $100,000 was set aside from the U. S. Government's civilian pilot training program to develop new and better methods for selecting and training pilots.

Brain wave study revealed that a chemical pacemaker controls the brain's activity through cell respiration, promising new understanding of brain syphilis.

Blood tests revealed that cell respiration in the brain is heightened during the fever treatment for the mental disorder paresis, brain syphilis, throwing new light on how the treatment benefits.

Engineering and Technology

A PRACTICAL way of extracting the important metal manganese from low-grade ores was developed in 1939; also the use of small amounts of lead in steel to improve greatly its fabrication properties.

The U. S. Navy opened its new $4,500,000 towing tank at Carderock, Md.

Gas turbines which in wartime emergency can be buried underground with only fuel and air inlet and an electric cable outlet were developed in Europe and already several are in operation in the United States in industrial plants.

Commercial production was begun of high test gasoline, using sulfuric acid as the chemical catalyst.

The *S.S. America*, 30,000-ton passenger liner and largest ever built in America, was launched.

Commercial development was undertaken of frequency modulated radio transmission which makes possible transmission without interference from natural or man-made static.

The fulchronograph, a rotating magnetic lightning recording device, was developed, which successfully measured the maximum current of a direct lightning stroke and charted its complete wave shape.

By a new process of insulating telephone wires the number of wires which can be placed in present size cables was increased by 606 to a total of 4,242 wires.

Accurate values for the viscosity of steam up to pressures of 2,000 pounds and temperatures of 1,100 degrees Fahrenheit were established.

Scheduled television programs, after many years of laboratory experimentation, were inaugurated.

Shasta Dam, irrigation project in the Sacramento-San Joaquin Valley, Calif., was begun.

The Federal Government began the acquisition of strategic mineral stockpiles with a $10,000,000 purchase fund.

Iron 99.99 per cent. pure was made to serve as a spectroscopic standard.

Medical Sciences

THE pneumonia case fatality rate was materially cut in 1939 by use of the new chemical remedy, sulfapyridine, while this and the related chemical, sulfanilamide, were reported promising in treatment of smallpox, primary peritonitis in infants, certain tropical diseases, infection with hemophilus influenzae (not virus influenza), tularemia, trichinosis, otitis media, gonorrhea, meningo-encephalitis of dogs, chronic ulcerative colitis; not useful in tuberculosis; and an effective vital stain for plant and animal tissues.

The National Cancer Institute at Bethesda, Md., was completed and occupied by its cancer research staff.

New buildings for Memorial Hospital for the Treatment of Cancer and Allied Diseases, in New York City, were completed.

A bill to extend medical and health services throughout the nation through a national health program was introduced into the Senate by Senator Robert F. Wagner, N. Y., and hearings were held and a preliminary report made, but the bill was not reported out of committee before Congress adjourned.

Refrigeration of human cancer patients to the point of artificial hibernation gave relief of intractable pain in more than 80 hopeless cases with regression of the tumor in some.

Cases of ulcerating x-ray and radium burns were cured with no recurrence during 10 years and probably prevented from becoming cancerous by treatment with alpha rays, beryllium and boron.

Treatment of cancer by neutron rays from the cyclotron was started.

"Cocktails" of radioactive sodium phosphate proved at least as effective leukemia treatment as x-rays in preliminary human trials of what is hoped will prove a "cure" for this fatal disease.

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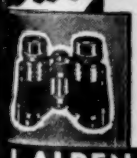

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SCIENCE NEWS

Science Service, Washington, D. C.

SUPER-EXPLOSIONS OF STARS IN DISTANT NEBULAE

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THE discovery by the collaborative efforts of astronomers at Mount Wilson, Palomar and Harvard Observatories of three gigantic stellar super-explosions within sixteen years in a distant system of stars like our own Milky Way, has been reported through the *Proceedings* of the National Academy of Sciences by Dr. Harlow Shapley, director of the Harvard Observatory, and leads to the speculation that these catastrophic star flare-ups are much more frequent than has been suspected hitherto, at least for one special type of stellar system.

It may be that in a system of stars similar to our own, a tenth of the stars explode in a time equivalent to that since the earth's oldest rocks cooled. Heretofore the accepted rate of occurrence of these supernovae, as they are called, has been one in 600 years for any one system.

Dr. Fritz Zwicky, of Palomar Observatory, and Dr. E. P. Hubble, of Mount Wilson Observatory, found two of the supernovae, one of which was also independently found on Harvard plates. The third was found on Harvard plates of 1921 by Miss R. Jones. This third supernovae actually exceeded at its peak brightness all other light from this northern nebula NGC 3184 in which it is but one of the 100,000,000 stars or more. In each of two other nebulae two supernovae have appeared, separated by intervals of thirteen years in NGC 4321 and twenty-two years in NGC 6946.

All these great aggregations of stars are nebulae of the most developed, and presumably older, type, labeled Sc in astronomical tabulations. They have the flat side of their spiral disc toward us. Most interesting from the viewpoint of earth dwellers is their probable similarity to the "island universe" or nebula in which our sun, with its planets, is an average star. The myriad of stars we see in the sky on a clear night are part of our nebula.

Although a nebula like NGC 3184 is so distant that it takes light 4,000,000 years to travel from there to here, what happens there is important because it may indicate what could happen in any well-developed stellar system.

Seven of the 30 supernovae discovered so far are in the three nebulae. One of the two supernovae that exploded in our own stellar system was the outburst observed by the Chinese in the year 1054. This supernovae can now be seen as the famous Crab nebula. It is not an external nebula but a different kind of cloud, not of stars, in our system.

Occasionally a star in our own nebula becomes very much brighter for a time and rises to naked-eye brilliance, only to fade away and become obscure again. Such a happening is called an ordinary nova. A supernova is many thousands of times more energetic. It is probably the greatest catastrophe that man's eye can witness.

On the basis of the three supernovae in NGC 3184, Dr. Shapley suggests that the light of perhaps 200,000 more are in transit from that nebula to earth, a phenomenon due to the long time (4,000,000 years) that it takes light to reach us from the immense distance of that nebula.

CELLULOSE FROM THE AUSTRALIAN TREE CASUARINA

WOOD pulp for use in paper, guncotton, textiles and the other thousand uses of cellulose may be grown on "tree farms" of limited acreage in the warmer parts of the South, through the adoption of a fast-growing Australian tree, casuarina, is the belief of Professor Donald D. Bodé, of the department of chemistry of the University of Tampa.

Casuarina trees will grow 35 feet high with nine-inch trunks in six years; 56 feet high with 17-inch trunks in 12 years. They will produce from four to six cords per acre per year, as compared with one cord per acre per year for Southern jack pine. Moreover, a cord of casuarina wood is a fourth heavier than a cord of jack pine. The Florida State Forestry Service estimates that to supply a 200-ton mill with slash pine, 120,000 acres under forest management are needed. The same mill would be supplied by a 24,000-acre tract of casuarina.

Professor Bodé states that in fairly large-scale experiments he has produced 90 per cent. or better of alpha cellulose from casuarina pulp. Since ordinary commercial requirements for this purpose call for only 87 per cent., this would seem to be easily adequate. The pulp has been found good for book paper filler, but not as yet for newsprint. The best pulping process, so far as Professor Bodé's experiments indicate, is soda cooking. Considerably less bleaching compound is needed to produce good white alpha cellulose.

The tree can be grown on poor soil, down to the very edge of salt water. It should therefore thrive on the Florida keys and in the southern part of the peninsula, as well as elsewhere along the Gulf Coast. It must not be attempted, however, except where winter temperatures do not drop below a mean of 54 degrees Fahrenheit for the coldest month, and it must be carefully protected against fire, to which it is unusually sensitive.

The casuarina is a strange-looking but beautiful tree. It has no leaves; their place is taken by extremely slender, long, jointed green twigs, somewhat resembling the common horsetail or scouring-rush. It is sometimes called Australian pine, but it is not a pine; also beach she oak but it is not an oak. It belongs to a botanical family unrepresented in the North American flora and name for the tree itself: the Casuarinaceae.

VACCINE FOR PROTECTION AGAINST DISEASE CAUSED BY TICKS

(*Copyright, 1939, by Science Service*)

THE U. S. Public Health Service announces that a new vaccine for protection against a new and possibly wide-spread feverish ailment spread by ticks is ready for first trials on human volunteers.

The new vaccine, successful in guinea pig trials, was prepared by Dr. Herald E. Cox and E. John Bell, of the Rocky Mountain Laboratory of the National Institute of Health at Hamilton, Mont. It was made from germs from infected ticks and also from the same kind of germs grown on developing chick eggs.

A member of the Washington headquarters staff of the National Institute of Health was the first recognized human case of the new disease, which has been named *Rickettsia diaporica*. He contracted it while observing the results of research during a visit to the Hamilton laboratories. He recovered after about a month's illness characterized by mild fever with chills, recurrent sweating and tender finger joints.

The ease with which the infection was picked up in the laboratory, plus the fact that the infection occurs naturally in ticks, suggests that there may have been other human cases. The disease is very similar to, if not the same, as the "Q" fever of Australia. The fact that two such similar diseases exist at points so geographically far apart leads health authorities to believe that other cases must be occurring in both countries and probably in many countries between here and Australia.

The germs of another ailment, relapsing fever, have been discovered in a tick by the name of *Ornithodoros hermsi*, by another of the Rocky Mountain Laboratory staff, Dr. Gordon E. Davis. Reporting his findings in the Public Health Reports, he states that this species of tick is undoubtedly a local agent for transmission of relapsing fever in Colorado.

LEAF IMPRINTS IN SHALE NODULES

(Copyright, 1939, by Science Service)

BEAUTY is sought and found in about the unlikeliest of all imaginable places—the waste-heaps of soft coal mines—by George Langford, of Joliet, Ill. For him it is not a profession but an absorbing avocation, for Mr. Langford makes his living as manager of a manufacturing plant in Joliet. His spare time he spends botanizing the forests of 250 million years ago, as represented by the fossil leaf-remains embedded in the nodules of hardened clay cast out with the shaly waste from the coal pits of central Illinois.

Finding fine leaf-imprints in shale nodules is not particularly new in itself. Thousands of them are in geological museums and in private collections. The real contribution of Mr. Langford is the method he has developed for bringing out their full color and beauty, something not accomplished by the kind of handling hitherto employed. Leaf-forms that ordinarily show dull and colorless take on almost the sheen of living flowers.

A shale nodule is a more or less elongated oval lump of stuff that looks like hardened clay. Indeed it is hardened clay, solidified around a leaf, or twig, or insect, or other object that fell into the mud and became embedded there, ages ago when coal was in the making. If you turn it edgewise and give it a sharp rap with a hammer it will split apart, showing the convex or positive side of the leaf-print on the face of one of the halves and the concave or negative side on the other.

That is all that has been done with leaf-nodules hitherto—just split them open to show the contents. But in that state the leaf-prints are dull and rather uninteresting, due to their being covered with tightly sticking tiny mineral particles—literally the dust of ages.

Mr. Langford undertook to get rid of this millennial dust. His technique is something between a jeweler's and a dentist's. He uses the small, keenly pointed and edged tools of a dentist, plus a variety of brushes, to dislodge the mineral particles, and then carefully burnishes each small detail of the cleaned-up design by hand. No buffing wheel, however fine, is permitted to touch one of his precious specimens.

Most people, when they first see a Langford leaf-nodule preparation, imagine that it has been painted or enameled. This is not the case. No artificial color of any kind is added, no varnish, no shellac. A little colorless burnishing fluid is the only aid he employs. The colors are those latent in the minerals composing the specimen itself.

Mr. Langford states: "The stone of the strip mine nodules is very variable. All of it contains more or less iron. In some places it is a buff-colored and rather soft shale. Occasionally it is sandstone. The stone best suited for fossil preservation is very close-grained and hard, in varying shades of fawn, gray, light blue and dark blue. Weathering converts the iron content into oxide, producing red, which, combining with the stone colors, results in orange, brown, purple and other colors. It remained for us to develop these colors by accentuating them in the plants and suppressing them in the surrounding stone. The result is a fine reproduction of the plant in color, and of surprisingly lifelike appearance."

The plant remains brought out by Mr. Langford's method are almost all leaves of ferns and fern-like plants, which were the highest forms of vegetation on the earth during the coal age. Higher flowering plants did not appear until much later. It is in the leaves, therefore, their delicate venation and smooth surface texture, that the greatest possible development of beauty must be sought.

THE MEDICAL SCIENCES IN 1939

(Continued from December 22)

Prevention of 50 per cent. of deafness in adults is the future accomplishment expected from the discoveries that hyperplastic lymphoid tissue in and around the orifice of the eustachian tubes during childhood is the cause of middle ear deafness, that the condition can be detected by nasopharyngoscopic examination and that it can be checked by radium treatment.

Important development in the fight against infantile paralysis was the successful transmission of the virus to the Eastern cotton rat, which for the first time gives another animal than man or monkey for investigations looking toward a cure or preventive of the disease.

"Hormone banks," new technic in endocrine therapy evolved by English scientists and consisting of burying several months' supply of hormone in pellets under the skin, was successfully used in cases of Addison's disease and hypogonadism in both males and females.

Adrenal glands from animals were implanted under the skin of Addison's disease sufferers with more or less improvement in mild cases and improvements lasting 5 to 6 months in severe cases.

Male sex hormones were found to be of utility in treatment of reproductive-system disorders in women.

Tanning from exposure to sunlight was shown to be importantly dependent upon sex hormones.

Noma, serious human mouth ailment, was produced for the first time in monkeys by a deficient diet in studies indicating that dietary deficiencies rather than germs may

be responsible for other human mouth and tooth ailments such as trench mouth.

A nation-wide drive to eradicate gonorrhea, second "hush-hush" plague, was started by the U. S. Public Health Service.

The American Museum of Health, first institution of its kind in the United States, was established in New York City.

Vitamins B and C were found useful remedies for retinal bleeding in diabetes.

Cultivation of rabies virus outside the brain of a living animal, once considered impossible, was accomplished and may make antirabies vaccine production easier.

New x-ray technic was developed for detecting placenta praevia by sixth month of pregnancy, thus allowing time to save both mother and baby from this often fatal complication.

Fluorine in drinking water, known to be the cause of mottled enamel of teeth, may act, according to some new observations, as a preventive of caries.

Apparent cure of hitherto incurable and rare scleroderma by parenteral treatment with an acid preparation known as Aciform II was announced.

The common gray house mouse was discovered to be a carrier of the causative virus of the human nerve disease, choriomeningitis.

Riboflavin, one of the B vitamins, is necessary for human nutrition, it was discovered from investigation of cases of ariboflavinosis, condition formerly confused with pellagra.

Partial sex determination by diet was achieved in rats, high protein diet fed the male parents and low protein to the female parents resulting in a sex ratio of 145 males to 100 females in the offspring.

Injections of the chemical, xanthine, were found to prevent jaundice and other liver damage in animals, a discovery believed useful for combatting human liver damage from solvents used in industries such as dry cleaning, plastics and certain manufacturing processes.

ITEMS

ROCKS that form the crust of the earth have never been very hot—not more than 1,200 degrees Centigrade—in the opinion of Professor Norman L. Bowen, of the University of Chicago. He bases his assertion on the known melting and crystallizing points of crustal minerals. Some stones now at the surface have higher crystallization temperatures; diamonds, for example, but Professor Bowen points out, "We have no evidence that in their surface position diamonds were ever in any but crystal form." What temperatures were at great depths in the earth's earlier days, he adds, we do not know and probably never shall.

GLACIAL periods on the earth have been due to changes in the sun's radiation, according to an article by Sir George Simpson, the British meteorologist, in the annual report of the Smithsonian Institution. However, these big chills have come not when the sun, now known to be a variable star, was growing cooler, but when it was throwing out more heat. It works out this way: the increased heat causes increased evaporation from the oceans; this in turn produces greater precipitation. Near the Poles, this precipitation piles up as snow that packs and solidifies into ice—and the Ice Age is on the way. If the sun puts a damper on its radiation for a long period, evaporation slows down and the lands become dry. Sir George believes that we are living in such a cold, dry epoch now.

GLYCERINE has been turned to practical use in saving millions of young tomato and cabbage plants from dying in shipment through drying out of their roots. The method was worked out by Dr. R. N. Du Puis, industrial chemist of Chicago. Tomato and cabbage plants are grown in the South and shipped North by millions, their roots packed in moist sphagnum moss. It occurred to Dr. Du Puis to substitute a glycerine solution for the plain water, so that if the moss pack dried out there would still be a protecting layer of glycerine over the roots. Large-scale experiments gave encouraging results, and last season the method received a full-scale commercial workout. More than 75 million plants were shipped with glycerine-solution protection.

MORE, not less, vitamin A foods must be eaten as people get older, it appears from discoveries by Drs. J. T. Irving and M. B. Richards, of Rowett Research Institute, of Aberdeen, Scotland. The explanation probably is that the vitamin A needs of the body are related to body weight. Discoloration of rats' teeth gave the clue to the finding that the body needs more of this vitamin with increasing age. Changes elsewhere in the body seem to confirm this finding. Reporting their research to *Nature*, Drs. Irving and Richards point out that the increasing need for vitamin A with increasing age is in surprising contrast to requirements of other dietary factors, such as calcium and phosphorus. The need for these substances is not supposed to increase with age. Vitamin A is found in liver, particularly fish liver, and in green and yellow vegetables.

NEW kinds of soup, soup wafers, cheese and candies, made from dairy products by the Federal Bureau of Dairy Industry, are going to the Antarctic along with other supplies for the Byrd Expedition. The new foods are not yet on the market. They were devised to find ways of utilizing skim milk and whey. Whey powder was used in making the dried pea soup, which also contains split pea solids and fat. Potatoes, skim milk and salt make the soup wafers, which are said to be similar to potato chips except that they contain no fat and so will not turn rancid. Caramels and fudge for the expedition were made from a formula containing 25 per cent. whey solids. The American Cheddar cheese going on the expedition was made and packaged in valve-vented cans, a relatively new development in merchandising this type of cheese.

AN aviation-weather study, in which more than ten million separate observations at 239 major airports were used, will be published shortly by the U. S. Government. It will help airport planners to plan runway extensions and locate instrument landing systems. The work was done as a WPA project in New Orleans, more than 100 persons being employed. They extracted from the records of 239 airports data on visibility, wind direction and velocity, and other flying-weather factors and correlated it on punch cards for mechanical tabulation.

PREVIEW OF THE ANNUAL EXHIBITION

of the American Association for the Advancement of Science, The Civic Auditorium, Columbus, Ohio, December 27 to December 30

The exhibition of the American Association for the Advancement of Science will this year be held at the Civic Auditorium, Columbus, Ohio, from December 27 to 30.

We wish to express our appreciation for the cooperation that we have received from the exhibitors who have helped to maintain the high standards of the exhibition. Some institutions and concerns who have recently decided to take part in the exhibition have not had time to send descriptive material for publication in this issue of *Science*. A brief description of exhibits follows.

OWEN CATTELL,
Director of Exhibits

BAKELITE CORPORATION

New York
Booth No. 59

Of particular interest are working demonstrations on laboratory testing machines. These demonstrations reveal how Bakelite engineering laboratories test plastic materials for such properties as impact resistance, stiffness and power factor. In addition, are a stretchability demonstration of the new "Vinylite" polyvinyl acetal resin filler for safety glass, and a stress and strain analysis of Bakelite transparent cast resinoid models under polarized light. Supplementing these action features are forty case histories illustrating how Bakelite materials have aided in the solution of engineering problems, particularly by their resistance to chemicals and corrosion.

BATTELLE MEMORIAL INSTITUTE

Columbus
Booth Nos. 7, 8

The Institute will display photographs of scientific and industrial research in progress in its laboratories. A member of the technical staff will be in attendance to furnish information about Battelle, and to be of assistance to visitors.

BAUSCH AND LOMB OPTICAL COMPANY

Rochester, N. Y.
Booth Nos. 75, 84

A most complete display of optical apparatus including laboratory, research and wide field microscopes, microtomes, microscope accessories, microprojectors, Balopticons, photomicrographic equipment and optical measuring instruments will be set up for operation. Available new items will be shown. New features have also been incorporated on our established line of instruments. Our many friends are invited to pay us a visit. Messrs. J. H. Schering, H. L. Shippy and G. H. Leffler will greet visitors.

BIOLOGICAL ABSTRACTS

University of Pennsylvania
Booth No. 100

The only English language abstracting and indexing service which covers the entire field of biological literature. The abstracts are from more than 1,100 biological journals published in 18 languages throughout the world. This "Service to Science" enables the research worker to keep up with the ever-mounting current biological literature. Featured at the display will be the new sectional plan inaugurated in 1939. Dr. John E. Flynn, Editor-in-chief, Miss R. J. Feldman, Librarian, and Mr. Pierce W. Anthony, Business Manager, will be in attendance to explain the new section plan and point out the time-saving usefulness of *Biological Abstracts*.

THE BLAKISTON COMPANY

Philadelphia
Booth No. 88

The Blakiston Company will this year present at the Columbus Meeting an interesting exhibit not only of their new texts and references but their complete line in the various fields of science. New texts in Comparative Anatomy, Organic Chemistry and Inorganic Chemistry will be featured. Messrs. J. Brooks Stewart and E. R. Stetson will be in attendance, and Mr. Robert F. Bowman will be present one or two days.

BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH, INC.

Yonkers, N. Y.
Booth No. 98

Photomicrographs and x-ray diffraction patterns will be used to illustrate the formation of cellulose particles within the chloroplasts of *Halicystis* and within the colorless, plastid-like structures in the Cotton Fiber. The formation and structure of the cell membranes of these two cells from cellulose particles and other substances of protoplasmic origin will be demonstrated in a similar fashion along with samples of various membrane constituents. Dr. Wanda K. Farr will be in attendance.

CARNEGIE INSTITUTION OF WASHINGTON

Department of Genetics
Cold Spring Harbor, N. Y.
Booth Nos. 81, 82

Exhibit of results of induced polyploidy in flowering plants, by A. F. Blakeslee, A. G. Avery, A. D. Bergner, S. Satina, H. E. Warmke and E. W. Sinnott. Colchicine induces elimination of chromosomes as well as doubling total number. It may affect the three primary layers

differently producing chimeras in which one can determine what each germ layer contributes by differences in chromosome number. Characteristics of polyploids and effect of polyploidy on sex mechanism in Melandrium are illustrated. Three ways are shown in which "new species" may be made by laboratory methods. The first method is not yet known in nature; the second is suspected in nature; the third is known to have occurred in the origin of elite varieties of cultivated plants and many species in nature.

FRED S. CARVER
New York
Booth No. 60

The Carver Laboratory Press, now in use throughout the world in research and development work of many kinds, will be shown. This is standard apparatus which has been used particularly on most of the recent developments in plastics; it is also used for biological studies, pressing of plant and animal tissue and separation of liquids from solids; metallographic and various other applications—in the colleges, government departments and commercial institutions. The Press will be shown with its various accessories and methods of application for these different uses.

CENTRAL SCIENTIFIC COMPANY
Chicago
Booth Nos. 52, 53

The exhibit of the Central Scientific Company will again feature some of the new developments in the laboratory and research field and as many as possible of the display items will be in operation. Some of the interesting new developments include a spectrophotometer, which will be known as the "spectrophotelometer," to be made available at a price within reach of the average budget; several new light sources; a new low-priced hydraulic press with accessories for demonstrations and experiments on pressure transmission by liquids as well as the verification of Hooke's law; a horn gap spark discharge apparatus; and a number of new developments in demonstration lecture equipment.

CHICAGO APPARATUS COMPANY
Chicago
Booth No. 101

The exhibit of the Chicago Apparatus Company includes among many other modern items for Physics, Chemistry and Biology a new fool-proof Tesla Coil for high-potential, high-frequency demonstration work; new non-breakable Durolatex Anatomical Models of rubber; Visiograph Filmrols for preview and review work in physics, etc. Representatives in attendance: Dr. Edgar Baird, Nelson Worick and M. C. Stoelting.

CLAY-ADAMS COMPANY
New York
Booth No. 13

Clay-Adams will exhibit a number of new botanical and zoological models, and will also have available the "Durable" Anatomical Models of pressed paper, of interest to anatomists, physiologists and psychologists. Examination of this material will show readily the features which make some of these models outstanding for their relative completeness and lasting qualities.

THE COLEMAN AND BELL COMPANY
Norwood, Ohio
Booth No. 45

This exhibit will consist of Coleman and Bell Laboratory Reagents, including Inorganic and Organic Chemicals, Biological Stains, Chemical Indicators and Diagnostic Solutions. In certain instances, steps in the manufacture of certain items will be shown, including the raw materials and apparatus involved.

COMMERCIAL SOLVENTS CORPORATION
Terre Haute
Booth Nos. 1, 112

The production of the nitroparaffins and their derivatives, as shown in this exhibit, makes available to the chemical and process industries an entirely new group of organic chemicals which give every promise of attaining major industrial importance. The nature and properties of the nitroparaffins, and of the numerous compounds which can be synthesized from them, are so varied that practically every branch of industry will find these new chemicals of value in improving present products or processes and in developing new products. One of the most interesting characteristics of the nitroparaffins is their great versatility in chemical syntheses. They not only make possible the preparation of a very large number of new chemicals, but the reactions involved can in most cases be controlled to give the product desired in high yield. Mr. Walter Scheer and Dr. F. C. Dolian, of the Market Development Division, will be in charge.

DENOYER-GEPPERT COMPANY
Chicago
Booth No. 64

New accurate models made in our Chicago Studios await examination. On display will be models of the larynx, urinary apparatus, brain, skin, eye, ear, heart, and torso with head. Durably constructed of "Fibrine Composition," these visual aids will serve for years and will greatly increase the effectiveness of teaching efforts.

DUQUESNE UNIVERSITY BIOLOGICAL LABORATORIES
Pittsburgh
Booth No. 89

Dr. R. T. Hance will present the making of histological preparations showing speedier fixation; new dehydration methods; imbedding mixtures that may be varied in their application; and increased rapidity of staining. An exhibit prepared by Ralph Chermock will show the distribution of the relatives of *Papilio machaon* in North America, with their interrelationships being illustrated by their distribution and the environmental effects involved

in their coloration. Demonstrations of the facility with which microscopic slides of insect genitalia may be prepared involving cleaning, staining, the use of "Cellosolve" in dehydration, and mounting. The original charts used in teaching zoology to the blind will be shown.

EASTMAN KODAK COMPANY
Rochester, N. Y.
Booth No. 44

The exhibit of the Eastman Kodak Company features the new, versatile Kodak Precision Enlarger. This machine provides a comprehensive series of highly advanced equipment. In addition to a series of matched lenses and condensers, accessories are shown which readily adapt the Enlarger for use as a camera. In this connection it may be used for out-of-the-ordinary jobs such as copying and titling, and photomacrography and photomicrography of laboratory specimens. Another accessory makes it easy to use the Enlarger as an independent camera. Other new equipment such as an enlarger for miniature slides is shown also. Mr. Wm. S. Allen and Mr. H. J. Christy will be in attendance.

FORD MOTOR COMPANY
Dearborn, Michigan
Booth No. 42

The Johansson Gage Block exhibit will consist of various sets of Johansson Gage Blocks and Accessories. Several demonstrations of how these accurate gaging tools may be used will be on display as well as a series of 70 slides in an Automatic Balopticon. Chrome-plated Johansson Gage Blocks will be exhibited for the first time. The exhibit will be in charge of Mr. O. E. Green, assisted by Mr. O. L. Kelley.

GRADWOHL LABORATORIES
St. Louis
Booth No. 6

This organization will demonstrate new and accepted methods of blood typing and blood grouping. The work will show the up-to-date and complete methods for blood typing in connection with blood transfusion. Special attention will be given to the subgroups of A, namely, A_1 and A_2. In addition to this, the genetics of M and N groups will be related and demonstrated. The M and N groups are of great importance in determination of paternity. Parasitological demonstrations will also be made in this exhibit. Mr. and Mrs. Lucian Erskine will be in attendance.

GRAF-APSCO COMPANY
Chicago
Booth No. 78

As the originators of rebuilt microscopes in America, the Graf-Apsco Company features an exhibit of rebuilt equipment, together with their new instruments. It is interesting to note the contrast of old microscopes before and after rebuilding. Other items being exhibited are: Stereografs, dissecting instruments, magnifiers, etc., as well as a complete line of mechanical drawing instruments. Mr. J. M. Graf is in charge of the exhibit.

GUTHRIE CLINIC
Robert Packer Hospital
Sayre, Pa.
Booth Nos. 24, 25

This exhibit demonstrates the preoperative preparation for and the use of silk in the surgical treatment of hyperthyroidism. Displayed on cold front, especially built illuminators, using fluorescent lighting, negatives of patients before and after operation, eight photomicrographs of thyroid pathology, fifteen line drawings demonstrating the technique of thyroidectomy made by Didusch and reproduced on translite. A color, sound movie will be demonstrated, utilizing lateral projection on a silver surfaced mirror with the beam reflected on a translucent screen. The movie will display the actual operative procedure of thyroidectomy using silk sutures. Dr. S. Paul Perry and Dr. F. Harriman Jones, members of the staff, will be in attendance.

INSTITUTUM DIVI THOMAE
Cincinnati
Booth Nos. 72, 73

There will be shown effects of respiratory-stimulating factors from cells in changing the abnormal metabolism of tumor tissues so that it resembles that of normal tissues, by stimulating their respiration and depressing their aerobic and anaerobic glycolysis. The relation of this mechanism to natural and induced immunity to tumors in animals will be illustrated. Examples of the production of tumors by factors from injured cells will be exhibited. In the field of plant physiology, the rhythmic rate of growth of seedlings will be shown with the aid of the optical lever, and pollen tube culture will be demonstrated.

PROFESSOR CHAS. T. KNIPP
University of Illinois
Urbana
Booth No. 9

The exhibit will consist of two parts: (a) Cold Cathode Rectifier. This will be exhibited in improved form. Advantage is taken of the rectifying action when the Crookes dark space is limited by the physical dimensions of the discharge tube. The tube exhibited will rectify 25,000 volts A.C. By a proper placement of individual units the total rectification may be greatly increased. The operation of a single unit will be on display. (b) Molecular Bombardment. This is shown by two separate tubes operated simultaneously. The demonstration of a few years ago has been augmented by a companion tube showing the bombardment of mercury molecules on a disk of balsa wood placed within the tube. Conclusions regarding interatomic action may be drawn by studying and comparing the phenomena within the two tubes.

LEEDS AND NORTHRUP COMPANY
Philadelphia
Booth No. 29

Our display will include one new instrument and one newly redesigned. Speedomax, the high-speed recorder, has been redesigned to simplify, improve and standardize its construction. To demonstrate the fast response of this instrument, it records the emf of a Rayotube (radiation pyrometer) sighted on an intermittent target. An L&N Optical Pyrometer will be shown which is entirely new. Measuring by a combination of the optical-balance and potentiometric methods, it reads in degrees, and is designed to give fast, convenient and accurate temperature measurements. On display also is the Mueller Bridge for extremely high-precision temperature measurements by the electrical resistance-thermometer method and the portable Universal pH Indicator. Representatives in attendance will be Mr. C. E. Applegate, Philadelphia Office; Mr. J. F. Sneath, Cleveland Office.

BIOLOGY DEPARTMENT
Saint Louis University, St. Louis
(Professor B. J. Luyet)
Booth No. 86

An exhibit illustrating the States of Matter and Protoplasm at Low Temperatures: The vitrification gun, an apparatus for producing solid amorphous water by extremely rapid cooling; photographs of vitrified and devitrified water seen under the polarizing microscope; phase diagrams of the vitreous-crystalline states of water and of some carbohydrate solutions; the nature of the vitreous state, specimens of vitreous and partially devitrified matter; plants grown from seeds exposed to −195° C. below zero; entire plants which had survived exposure to this temperature; action of freezing temperatures on animals (fishes and lower forms).

McGRAW-HILL BOOK COMPANY
New York
Booth No. 58

Advance proofs of important forthcoming books in the field of science will be on display at the McGraw-Hill booth. You are invited to see at this booth also an exhibit of recent McGraw-Hill books in the fields of Agriculture, Astronomy, Biology, Chemistry, Education, Forestry, Geography, Geology, Mathematics, Metallurgy, Physics and Psychology.

THE MACMILLAN COMPANY
New York
Booth Nos. 56, 57

The book exhibit sponsored by The Macmillan Company contains approximately eight hundred and fifty volumes—undergraduate and graduate text-books, reference books, and technical and scientific books designed for the general reader. The following classifications are represented: Agriculture, the Biological Sciences, Chemistry, Engineering, History of Science, Home Economics, Mathematics, Medical Science and Physics. The following representatives of The Macmillan Company will be in attendance at the booths: Mr. Ranald P. Hobbs, Mr. Charles L. Skelley, Mr. Dwight Hoover, Mr. Donald M. Nelson, Mr. John S. Crossman and Mr. Arthur Evans.

MERCK AND CO., INC.
Rahway, N. J.
Booth Nos. 62, 63

The display is devoted entirely to the theme of synthetic vitamins, in which the company is particularly interested. A central panel, headed by an illuminated representation of crystalline vitamin B_1 carries a rope model diagram which traces the origins and inter-relationships of the various members of the vitamin B complex. Brief descriptions are given of riboflavin, nicotinic acid, pantothenic acid, vitamin B_6 and vitamin B_{12}, and a translucent colored chart shows the complete synthesis of the latter vitamin according to the procedure of Williams and his coworkers. Large molecular models of the structure of the vitamins C, K, B_6 and E are displayed. The syntheses of vitamin K and of vitamin B_6 as determined in the Merck Research Laboratories are shown in detail, in the two main panels. Descriptive detail and information are given concerning vitamins C and E. Dr. C. R. Addinall will be in charge of the exhibit.

THE NATIONAL GEOGRAPHIC SOCIETY
Washington, D. C.
Booth Nos. 30, 31

The exhibit of the National Geographic Society will feature a full-size facsimile of the ancient Mexican stone monument on which the oldest recorded date yet discovered in the Western Hemisphere is carved in Maya symbols. The date is equivalent to November 4, 291 B.C., and the stone on which it is recorded was uncovered by a joint expedition of the National Geographic Society and Smithsonian Institution. The monument is considered to be one of the most important archeological finds in the Americas. The exhibit will include photographs of other objects found by the expedition and of its work in the field. Mr. E. John Long and Mr. F. Barrows Colton of the staff will be in attendance.

THE OHIO STATE UNIVERSITY AND COOPERATING INSTITUTIONS
Industrial Research Foundation
Booth No. 27

The Ohio State University Research Foundation will display photographs, charts and literature illustrating its work in bridging the gap between academic research and the applications of research in industry. Emphasis will be placed on the educational value of bringing scientific problems arising in industry to the attention of university scientists and of acquainting industrial executives with the contributions that can be made to industry by scientifically trained investigators. Dr. A. R. Olpin and Mr. J. M. Weed will be in charge.

BIOCHEMICALS
OF NUTRITIONAL INTEREST

Carotene and various carotenoid pigments, in crystalline form, oil solution and aqueous colloidal suspension.

Thiamin Chloride

Riboflavin—natural and synthetic, in crystalline form and in concentrates.

Nicotinic Acid, Nicotinic Acid Amide and biologically important derivatives.

Ascorbic Acid

2-methyl-1,4-naphthoquinone
2-methyl-1,4-naphthohydroquinone diacetate
(Two compounds above exhibit vitamin K properties)

Pimelic Acid

Beta Alanine

Glutamine

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Depts. of Physics and Electrical Engineering
Booth Nos. 18, 19, 20, 76, 77

The Department of Physics of Ohio State University will exhibit equipment used in nuclear research. Diffraction of light by supersonic standing waves in a liquid will be demonstrated. The Department of Electrical Engineering will show acoustical models of radio antenna systems, which have been used with marked success in predicting the radiation patterns of radio antenna. Sound sources and pick-up devices developed for this work may find application in purely acoustical problems. The transmission of electromagnetic waves down pipes may be described as single-conductor transmission of power. The apparatus on exhibit is being used in studying more efficient methods of transferring power from the source to the guide, and of converting the transmitted energy into available form at the far end. Mr. Edward Jordan and Mr. Sloan Robertson will be in attendance.

Astronomy on the Pacific Coast
Booth No. 34

The center of attraction will be a large celluloid model of the giant 200-inch telescope now being erected on Mount Palomar in California. The model was constructed at a cost of $2,000, and it shows all the intricate features of the great telescope. Drawings by Russell Porter will illustrate the telescope in its natural setting. A photographic map of the Milky Way, from the Mount Wilson Observatory, shows the location of Cepheid Variable Stars. Other exhibits from Mount Wilson are photographs of celestial objects taken through filters of various colors. The Lick Observatory has contributed photographs showing the moon at various phases, enlarged sections of the moon, the Pleiades, several prominent nebulae and Director Wright's famous photographs of Mars and San José in violet and infra-red light.

Astronomy in Ohio
Booth No. 35

Here may be seen a model of the proposed new observatory for Case School of Applied Science. The large telescope will be of the new Schmidt photographic type. Photographs of the little observatory on the campus of Western Reserve Academy, at Hudson, and its founder, Elias Loomis, will be featured. This small observatory is 101 years old, and it was the first astronomical institution to be erected west of the Allegheny Mountains. Photographs of numerous Ohio observatories will be shown. Pictures of the Perkins Reflector, now fifth largest telescope in the world in operation, its new spectrograph and spectra recently obtained may be seen.

Astronomy in the Eastern United States
Booth No. 36

Interesting astronomical information will be illustrated by several models. Transparencies illustrating the work of the Michigan Observatory and the U. S. Naval Observatory will be on display. The Michigan Solar Observatory and its South African telescope will be illustrated. Contact prints from the star-chart plates of the Cook Observatory may be seen. Samples of the research work carried on at the Sproul, Allegheny, Dearborn, Yerkes and Harvard Observatories will be featured. The Harvard exhibit should be of particular interest to astronomers, since it contains recent photographs of objects in the southern heavens, not generally accessible to telescopes in the United States. Recent motion pictures of solar disturbances, from Michigan, will be shown in the projection room.

Plant Pathology
Booth Nos. 65, 66

Dr. Wolf, who last year supplied the interesting exhibit on blue mold, will again bring an exhibit to the Columbus meeting. Dr. Stakman will exhibit mutations and sexual relationship of fungi. Large paintings produced by an artist will make the exhibit outstanding. Helminthsporium and Stewart's disease on Dent Corn Hybrids will be the subjects of an exhibit by C. W. Ellett.

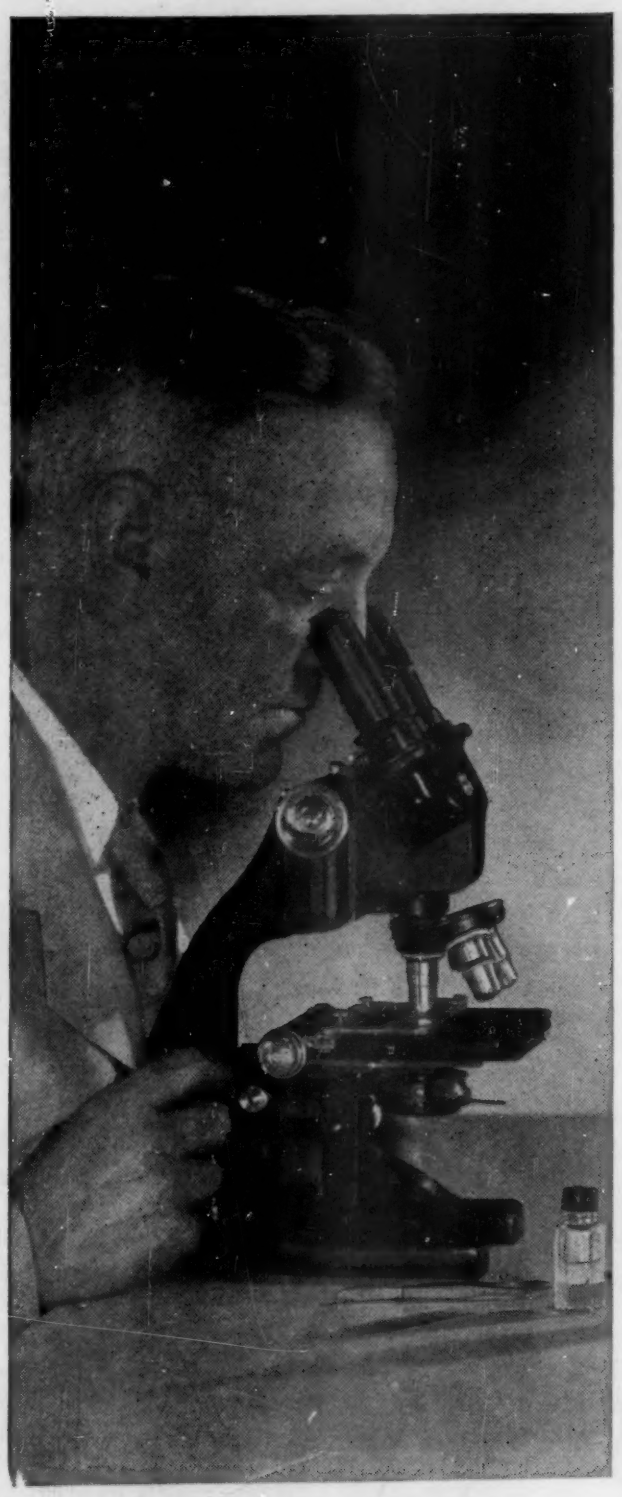
Phonetics and Chemical Abstracts
Booth No. 28

An exhibit on experimental phonetics dealing with palatography (tongue-palate contact). Pseudo palates with false windows connected by small tubing to tambour and kymograph are used to show how rate of articulation is related to area of palatal contact. These contacts are photographed, enlarged and measured with a planimeter. Dr. E. R. Moses, Jr., will be in attendance. The editorial office of *Chemical Abstracts*, which is located on the campus of Ohio State University, will be represented by a display illustrating the preparation of abstracts and indexes.

Engineering Experiment Station
Booth No. 99

The problem of three-dimensional photo-elastic stress analysis has been nicely solved by Royal Weller in the Engineering Experiment Station of The Ohio State University. It consists essentially of slicing a strained solid model by means of a thin light beam or band. The light band is applied at right angles to the line of sight and moved parallel to it. The fringe pattern produced is only that of the part of the model illuminated. A somewhat different mathematical procedure from the ordinary has been developed by him for quantitatively analyzing this fringe pattern. He has also developed an iterative procedure for analysis. The experimental apparatus for this method will be set up and operated. Mr. H. J. Hoffman will be in charge.

...when the Scientist says,



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PRENTICE-HALL, INC.

New York

Booth No. 43

Important new scientific publications are again featured in the book exhibit presented by Prentice-Hall. The display includes undergraduate and graduate texts in Physics, Chemistry, Mathematics and Engineering, as well as in Psychology, Geography and the Social Sciences. Of outstanding interest are Herzberg's "Molecular Spectra and Molecular Structure," Albright's "Physical Meteorology," Rollefson and Burton's "Photochemistry," Middleton and Willard's "Semimicro Qualitative Analysis," Taylor's "Vector Analysis" and "Applied General Statistics" by Croxton and Cowden, all recent publications. Also featured are Haskins' "Of Ants and Men" and Strong's "Procedures in Experimental Physics." Mr. Warrington and Mr. Daley will be in charge.

W. B. SAUNDERS COMPANY

Philadelphia

Booth No. 46

The exhibit will include their complete line of text-books and reference volumes dealing with the medical and biologic sciences. Of special interest will be the new text-book of "Clinical Biochemistry" by Cantarow and Trumper; also, Bliss, "Introductory Guide to Biochemistry," Sturtevant and Beadle, "Introduction to Genetics," McNally, "Medical Jurisprudence and Toxicology," King and Roser, "Anatomy and Physiology Laboratory Manual." There will be new, revised editions of several standard works such as Todd and Sanford, "Clinical Diagnosis by Laboratory Methods," Marshall, "Human Anatomy," Schneider, "Physiology of Muscular Activity," Bogert, "Nutrition and Physical Fitness," McLester, "Diet and Nutrition in Health and Disease," Wolf, "Endocrinology." Representatives in charge of the display are Messrs. E. R. Zieber and John A. Behnke.

THE SCIENCE PRESS PRINTING COMPANY

Lancaster, Pa.

Booth No. 55

Publications printed by The Science Press Printing Company will be exhibited. Books and journals can be examined and orders placed. Blanks for inclusion of biographies in "American Men of Science" and "Leaders in Education" can be filled out. Information and suggestions will be given concerning the methods and costs of scientific printing. Mr. Jaques Cattell will be in charge.

SOCIETY FOR RESEARCH ON METEORITES

The Ohio State University

Columbus

Booth No. 23

The exhibit of the Society for Research on Meteorites will feature a working model of a meteorite detector and a collection of meteorites recently discovered by instrumental search; a Missing Meteorite Bureau; models of meteorite craters; collections of tektites, meteoritic iron artifacts and pseudo-meteorites; specimens of rock metamorphosed by meteoritic impact; collections of transparencies, photographs and literature relating to meteorite craters, the great Siberian meteorite fall, the recently discovered Tilden, Paragould and Goose Lake Meteorites and modern work in meteoritics in the United States; a reticle used in plotting the apparent paths of meteors and many other items relating to meteoric astronomy.

SPENCER LENS COMPANY

Buffalo

Booth Nos. 38, 39

Visitors who come to the display of Spencer Lens Company will have ample opportunity to inspect and have demonstrated to them Spencer instruments that combine latest developments. Of particular interest will be the new low power binocular microscopes and the new Spencer Pathologist's microscope. Research and Laboratory microscopes, microtomes, photomicrographic equipment, Delineascopes and many other scientific instruments will be arranged so that visitors can easily see them in operation. Mr. J. P. Baker, Mr. J. J. Host and Mr. A. H. Fleck will be in attendance to discuss any optical questions visitors have in mind.

UNIVERSITY PRESSES

A Cooperative Exhibit

Booth No. 33

Fourteen university presses will display recent publications reporting and interpreting original research and scholarship, text-books exemplifying new methods, and proceedings and reports of learned societies. Miss Doris Force, of the University of Chicago Press, will be in charge of the exhibit in which the following presses will participate: California, Chicago, Collegiate (Iowa State College), Columbia, Cornell, Duke, Harvard, Minnesota, North Carolina, Oklahoma, Oxford, Princeton, Stanford and Yale.

U. S. BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C., IN COOPERATION WITH THE BIOLOGICAL INSTITUTE OF SAO PAULO

Booth No. 83

Exhibits: (1) Myriangiales, especially those of the genus *Elsinoë*, as they attack economic plants or their relatives in the United States, Puerto Rico and Guam, together with photographs and color drawings, the specimens representative of "Myriangiales Selecti Exsiccati," Fasc. II, in preparation; (2) Parallel agar media cultures of *Myriangium* and *Elsinoë* species for comparison of characteristics. Dr. Anna E. Jenkins will be in attendance.

U. S. DEPARTMENT OF THE INTERIOR

Geological Survey
Washington

Booth Nos. 2, 3, 4, 5

The exhibit shows recent activities of the Division of Ground Water of the Geological Survey, United States Department of the Interior. It includes: (a) graphs showing several different types of fluctuations of water levels in wells, including unusual fluctuations caused by trains, earthquakes, ocean tides, earth tides and changes in barometric pressure; (b) graphs showing long time records of fluctuations of wells in several widely scattered parts of the United States, some of them going back to 1892; (c) photographs showing equipment used to explore deep wells for leaks and contamination by salt water, with graphs showing results of such exploration; (d) graphs of fluctuations of ground-water level obtained during a current investigation in the vicinity of Cincinnati.

VASSAR COLLEGE

Department of Botany

Booth No. 15

The structure of some chloroplasts will be demonstrated by means of photomicrographs. These will show a surface view of chloroplasts not containing starch, showing plastidules and some containing starch also showing plastidules. There will be median optical views of the above. Kodachrome slides of chloroplasts will be shown daily. There will also be models. The above will show the *plastidule units* of which the chloroplast is composed and the *plastid granules* of which the *plastidule* is made. The chlorophyll will be shown to be present in the colloidal substance of the *plastid granule* and the starch unit, when present, will be seen in the center of each *plastid granule.*

VIRGINIA AGRICULTURAL EXPERIMENT STATION, COOPERATING WITH DUKE UNIVERSITY, AND THE NORTH CAROLINA DEPT. OF AGRICULTURE

Booth No. 70

Investigating new methods for the control of plant disease. Quantitative methods basic to toxicological investigations of the effect of organic vapors on plants are illustrated. Living tobacco seedlings infected with a disease-producing agent, *Peronospora tabacina,* are subjected to known vapor concentrations of paradichlorobenzene. The specific or "eradicant" action of the vapor, with respect to the parasite, is demonstrated. Photographs of the disease, methods of field investigation and the effects of environment on the use of paradichlorobenzene vapors are shown. Application of these investigations to the control of tobacco downy mildew on the farm is illustrated. In attendance will be Dr. J. A. Pinckard, Ruth McLean and associates.

W. M. WELCH SCIENTIFIC COMPANY

Chicago
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The exhibit of the W. M. Welch Scientific Company will show, among many other special designs, samples of different sizes and rulings of Wood's Replica Diffraction Gratings with brilliant spectra concentrated in the first order; a new all stainless-steel No. 4030 Balance with 110-gram capacity and 1 centigram sensitivity; a new Slide-wire Rheostat with special, non-inductive Coors porcelain tube; A. H. Compton Chart of Electromagnetic Radiations; and a new series of Lecture-table Meters for simultaneous reading—complete D.C. Voltmeter and Ammeter in the same case, and the same combination with A.C. instruments.

JOHN WILEY AND SONS, INC.

New York
Booth No. 40

The display will consist of the recent books published in all the fields of science and technology covered by the publications of the company. May we suggest that particular attention be given to the following important new books: Burk's "Catalysis"; Lindsay's "General Physics for Students of Science"; Loeb's "Fundamental Processes of Electrical Discharge in Gases"; Mayer and Mayer's "Statistical Mechanics"; Turner and Henry's "Growing Plants in Nutrient Solutions"; Zworykin and Morton's "Television." The company will be represented at the exhibition by Mr. R. C. M. Gould, Mr. J. K. Maddock, Mr. R. A. Buckles, Jr., and Mr. K. G. Getman.

WILKENS-ANDERSON COMPANY

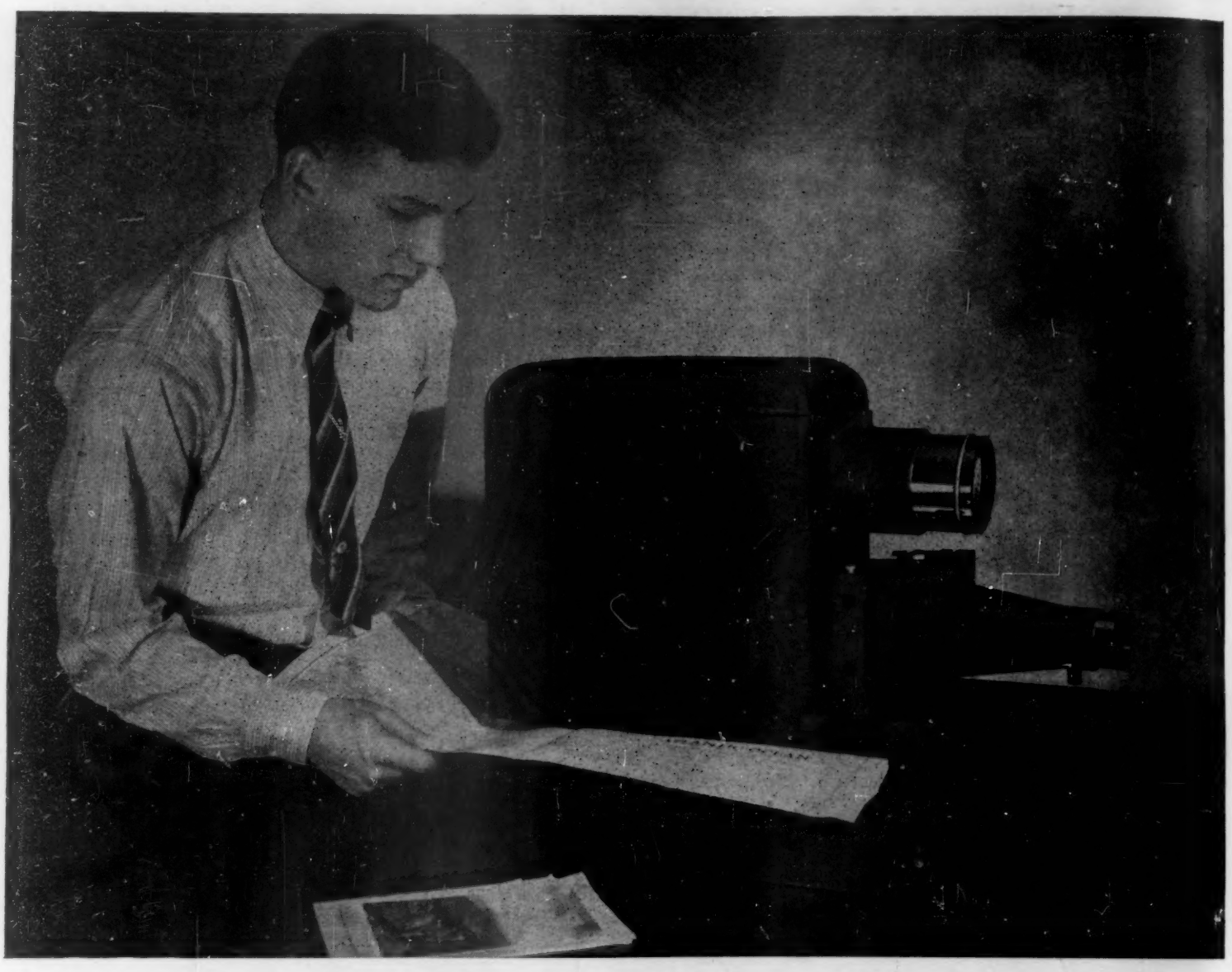
Chicago
Booth No. 54

High-lights of the WACO exhibit are the Semi-micro equipment for qualitative and organic chemistry, in which this company has pioneered. The KWSZ Photometer, developed at Purdue University, will be on display, and in this connection a 24-page booklet with abstracts of recently published technics, involving determinations using photo-electric colorimetry, will be distributed. The new Cameron pH Tester, as well as the more elaborate Cameron pH Meter, will be shown . . . both instruments use the glass electrode. Other equipment in the Chemical Laboratory Apparatus line, new and different, will occupy the balance of the space. Mr. F. A. Anderson and Mr. W. C. Burfischer will be in charge.

THE WILLIAMS AND WILKINS COMPANY

Baltimore
Booth No. 90

The Williams and Wilkins Company will display their complete group of 19 scientific periodicals as well as their most recent books. Among recent books are "An Outline of Physiology" by Amberson, "Bergey's Manual of Determinative Bacteriology" (5th edition), "Sex and Internal Secretions" (2d edition). Several new books in veterinary science will also be shown. Mr. E. F. Williams will represent the firm at the exhibit.



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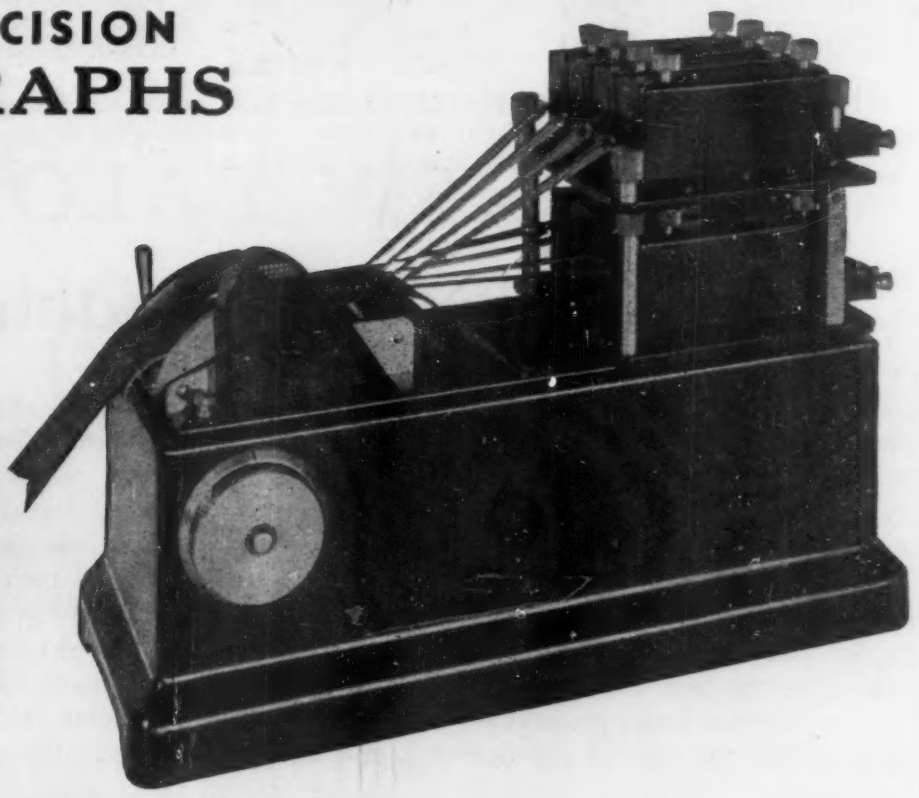

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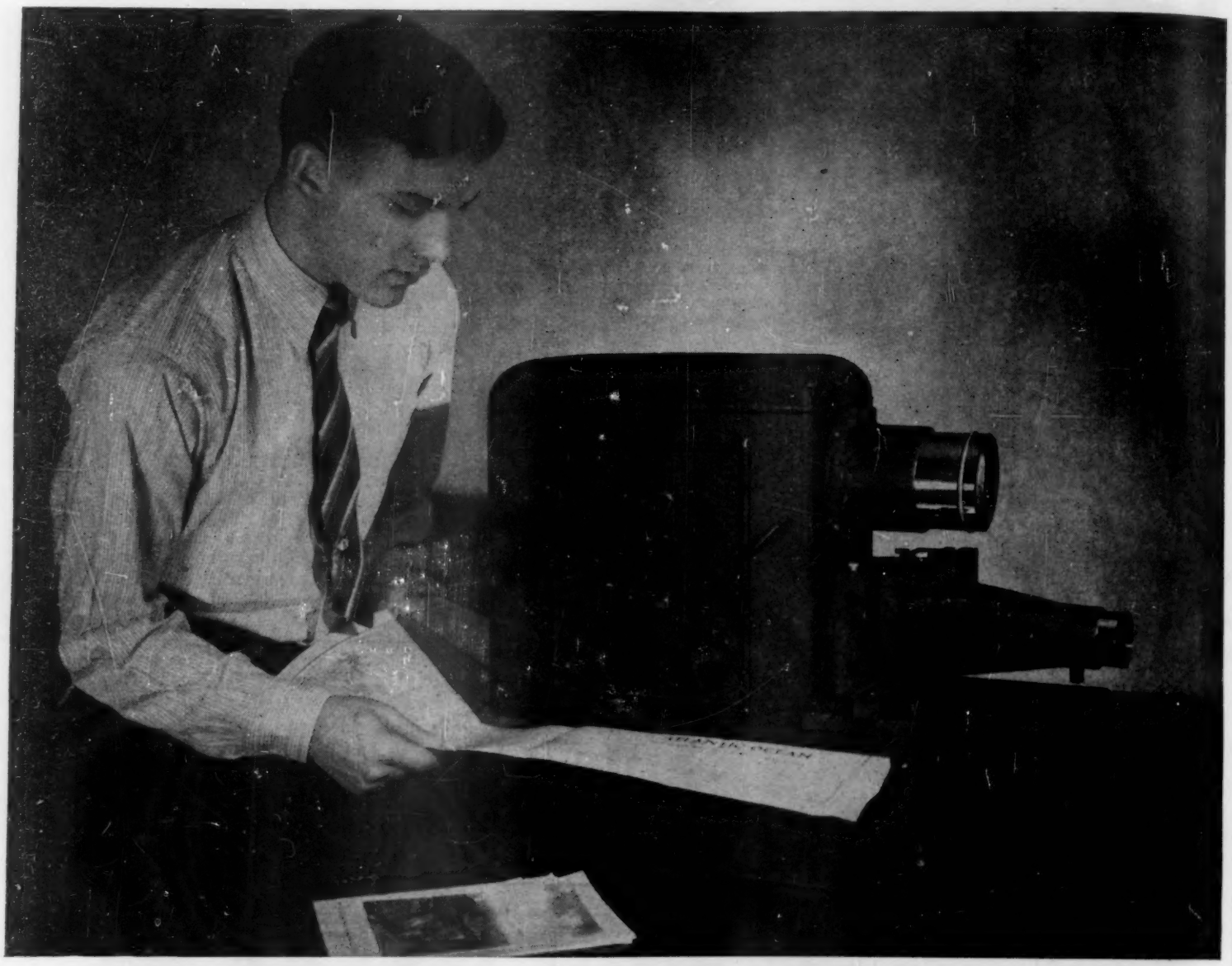

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